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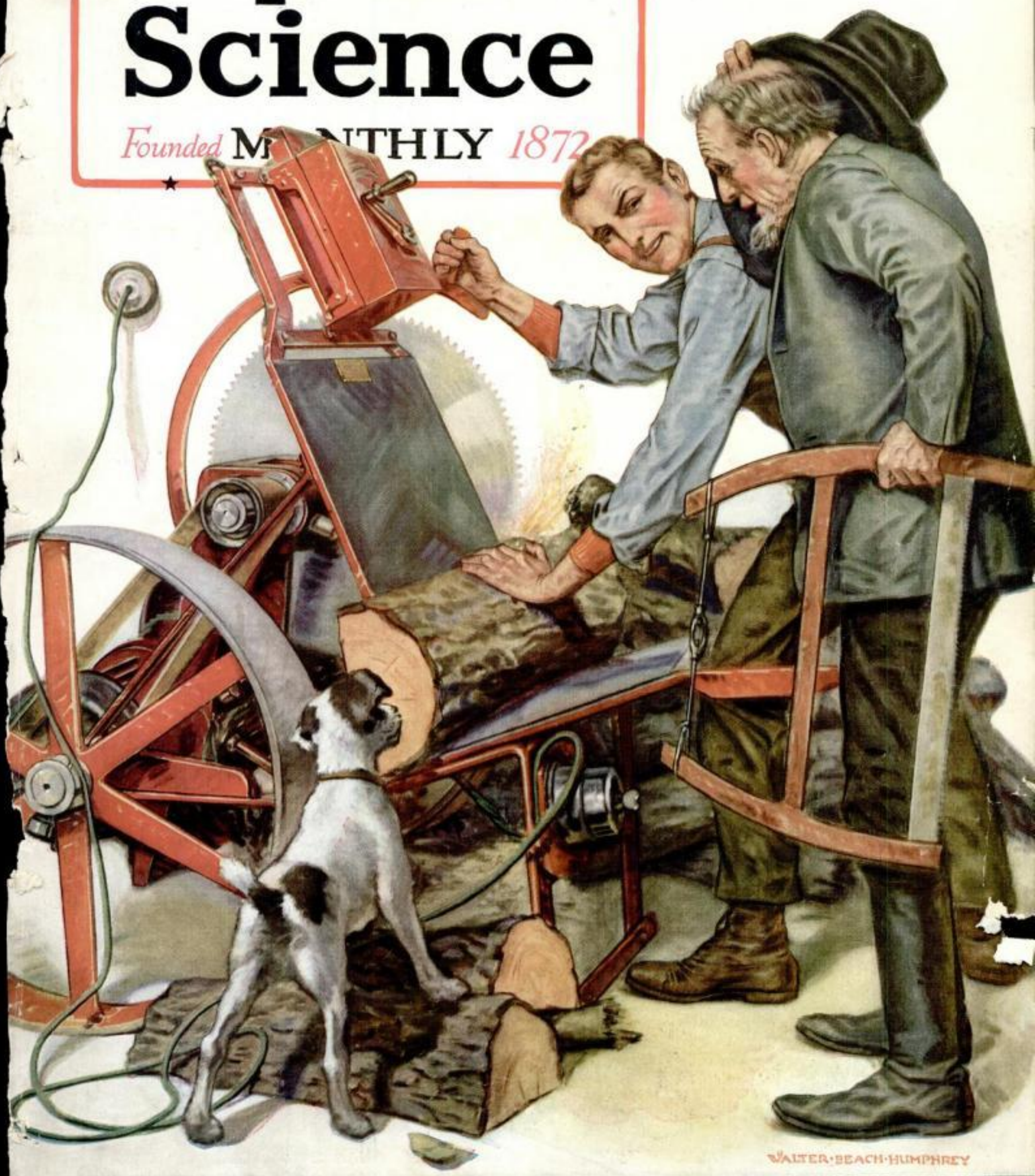

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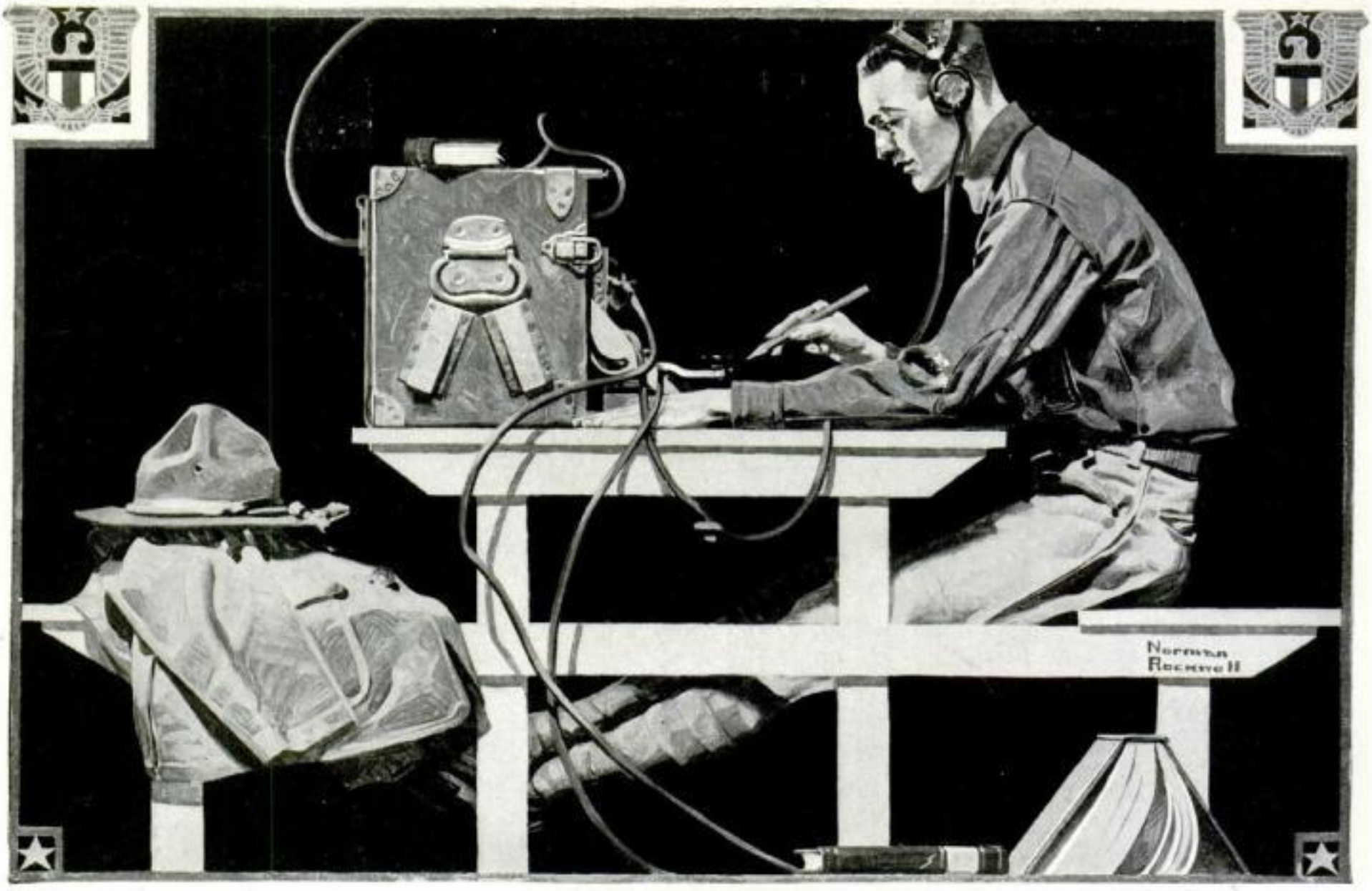


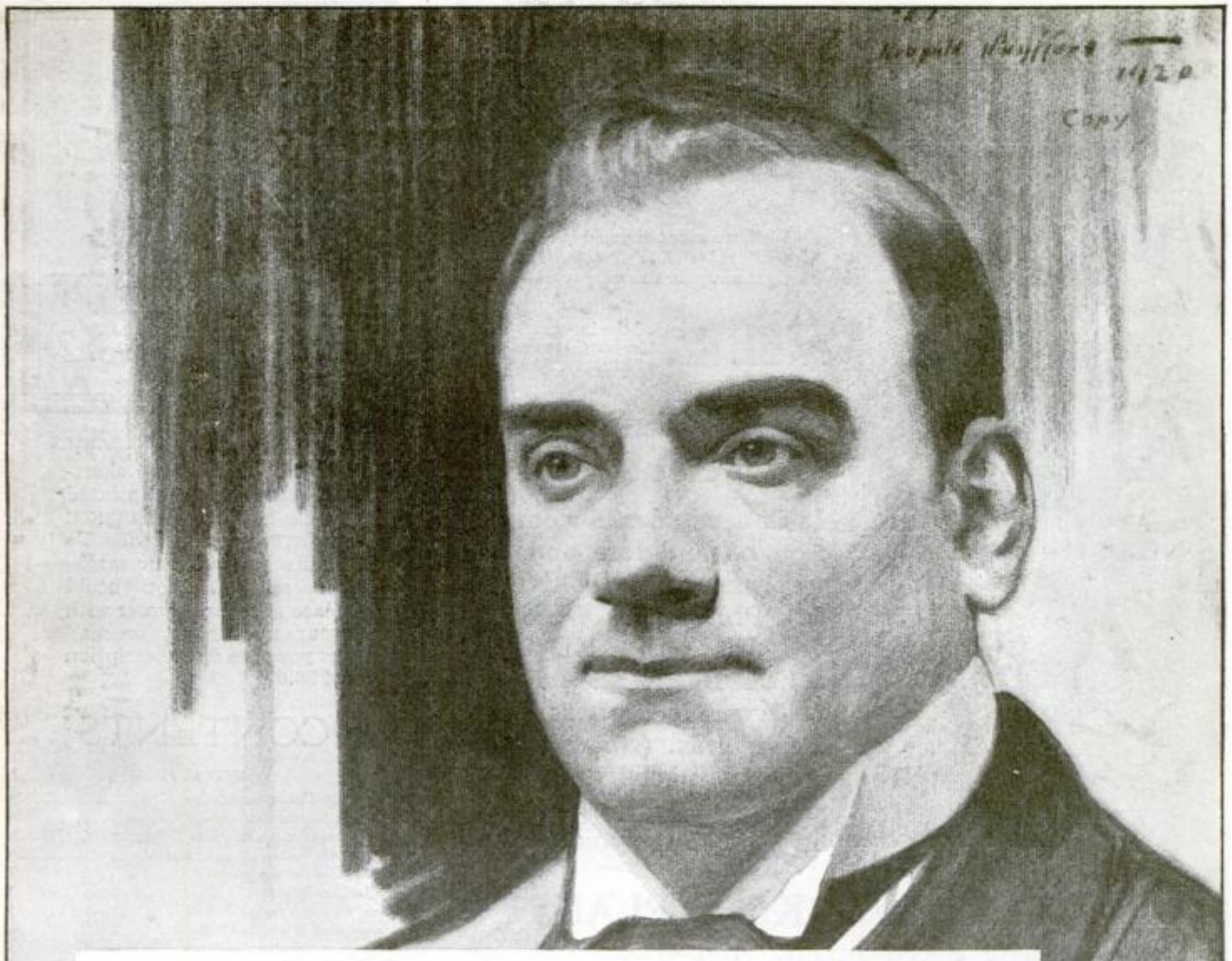
Get a fresh start—

IF YOU'RE IN THE WRONG JOB—start fresh. Learn how to do what you wish you knew how to do. Get that second chance you've been looking for! Learn to be an expert at a "technical" job—with the better pay that comes to a skilled man.

What if you haven't had the schooling necessary? The Army school will teach you almost anything from grammar school studies to one of a hundred trades. You earn a good living while you're learning. You get out of the old rut into new pleasant surroundings. You make new friends and find new opportunities.

THE US ARMY TEACHES TRADES

At Camp Grant, Illinois At Camp Meade, Maryland At Camp Devens, Massachusetts



Caruso immortalized

A vast heritage of arts and literature has been bequeathed to the world by the passing centuries, but it remained for the Victrola to perform a similar service for music.

It has bridged the oblivion into which both singer and musician passed. The voice of Jenny Lind is forever stilled, but that of Caruso will live through all the ages. The greatest artists of the present generation have recorded their art for the Victrola, and so established the enduring evidence of their greatness.

There are Victrolas from $25 to $1500. New Victor Records on sale at all dealers on the 1st of each month.

Victrola

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Victor Talking Machine Co.

Camden, New Jersey

This trademark and the trademarked word "Victrola" identify all our products. Look under the lid! Look on the label!

VICTOR TALKING MACHINE CO.
Camden, N. J.

Popular Science Monthly

FEB., 1921

Volume 98-No. 2

Important to Readers

Owing to the paper shortage, the number of printed copies of POPULAR SCIENCE MONTHLY is limited. To insure getting your magazine regularly, you should place a standing order with your newsdealer, or send us your yearly subscription of $3.00.

CONTENTS

(*Continued on page 4*)

POPULAR SCIENCE MONTHLY is issued monthly. Yearly subscription in the United States, $3.00. Canada, $3.50. Foreign, $4.00. Single copy, 25 cents.

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Modern Publishing Company
225 West Thirty-ninth St. New York City

How In One Evening I Learned The Secret of Drawing

By Walter Sayden

FROM boyhood, I have always wanted to draw things. I suppose there are hundreds of young fellows who feel the same way as I did. I often said that if it were possible, I should choose commercial art as a profession. It was not only the big salaries and independence enjoyed by artists and cartoonists that appealed to me, it was the fascination of the game itself.

He was drawing little pictures

But I could hardly draw a straight line. My friends used to have laughing hysterics at my attempts to sketch things.

One morning, as I was coming into town on the eight o'clock train, I met Larry Stafford. I had come into town with him every day for years, usually passing the time discussing the morning papers.

But this particular morning he had a pad and pencil in his hand. He was drawing little pictures of things that looked like a series of small animals.

"What on earth are you doing?" I asked in amazement.

Larry smiled. "Don't be afraid, I am quite sane. These little pictures are part of a scheme of mine. I am illustrating an idea. They are supposed to be a graphic representation of a deal I am putting over. They speak louder than words."

I watched him,—amazed to see that he drew very well indeed. As he proceeded, and the drawings became more life-like, my curiosity was aroused—I asked him about it.

"Why, I am surprised that you ask me!" he answered. "Look how easy it all is,"—and he quickly sketched a few other figures and grinned at my amazement.

"There is just one little secret of the whole thing, Walter," he added. "I never drew before in my life, and you see,—these little sketches really are not bad, are they? You have always wanted to draw, and even if you don't become an artist, you will find it a mighty convenient thing to know. This secret makes drawing as easy as writing. Let's get together this evening and I'll show you how simple it is. I'll give you a little lesson."

The Greatest Surprise of My Life

That night I was astonished to learn that there was but One Great Rule that covered every sort of drawing. I mastered this rule in just fifty minutes, and in two hours found that I could draw. Think of it! It was almost like magic. I had never before been able to draw a recognizable object.

At this time I was a salesman, so that the only time that I had to practice and apply this secret, this Rule, was in spare minutes when at the office or at home. But I progressed with almost unbelievable rapidity.

Mr. Charles Lederer, the well-known newspaper cartoonist, after years of practical working experience, has developed one great simple rule for success in all branches of commercial art. This amazing secret has revolutionized the entire theory of drawing. It means that drawing can be easy for *you* as writing. Out of his many years of work-a-day experience, Mr. Lederer offers this One Big Secret of Drawing to all.

My First Real Drawing

One day I was talking with a buyer. Remembering Larry's "idea-pictures," I drew some figures to illustrate the point I was trying to establish. He looked at the pictures and caught my idea at once. Before I left he gave me a larger order than I had ever before received from him. *My pictures* had put my idea over.

This worked so well, that I tried it again several times, in fact—and each time I got the same results. My pictures seemed to make a stronger appeal than my words, and my sales increased tremendously.

But that was not all. Two weeks later, I overheard a conversation that struck me as amusing. I wrote it down, illustrated it and just for fun, sent it to one of the humorous weeklies. A few days later, to my great surprise and pleasure, I received a check from the art editor and a request for more contributions.

From that time on, I sent in little sketches and jokes, more or less regularly. A few months ago, I received an offer which startled me. The magazine for which I had been drawing wished to take me on the regular staff at a much greater salary than I was then making.

My love of drawing came strongly to the front and, needless to say, I accepted at once, and the first thing I did was to tell Larry Stafford, what his idea had led to. When he heard that I was actually a successful artist on a real magazine he gasped with amazement.

I told him how the same One Great Rule of drawing which had made it easy for him to draw had meant even more to me—and how this simple home-study course by a famous artist, Charles Lederer, which we had gone over that evening, had given me the secret which had meant so much.

Larry laughed at my enthusiasm, but admitted that such a remarkable success as mine was enough to make a man a bit optimistic.

Easier than Learning to Operate a Typewriter

Through this amazing system, drawing can be *taught* as easily as anything else. In his simple, home-study course a world-famous cartoonist, Charles Lederer, teaches you to draw just as a business school teaches you to keep books, or operate a typewriter or write shorthand. But it is a hundred times simpler than any of those accomplishments.

And the best part of it all is that the course teaches you to draw so that you can *sell* your pictures right from the start. That is really the most important part after all. Everyone wants to sell his work, and that is just what you can do, with Mr. Lederer's great secret.

The most fascinating Business in the World

Don't misunderstand, I am not praising myself. The point is this,—if I, who never was able to draw at all, could achieve this really remarkable success, others can do the same, or better.

See for yourself,—send for the course and try it out. If you can draw at all you will probably get along even faster than I, and you will find modern commercial art the most fascinating and delightful work imaginable. Remember, that opportunities in this uncrowded field are unlimited. There is a constantly growing demand for cartoonists and illustrators. If you like to draw, or if you *think* that you *would* like to draw, don't miss this wonderful opportunity to learn in an evening or two of your spare time.

Five Days' Free Trial

We want you to prove to your own satisfaction the tremendous value of Mr. Lederer's discovery. It will not cost you one penny. We want you to examine the Entire Course at our expense for five days. If you will just fill out the coupon below, detach it and mail it to us, we will gladly send you the complete course for your approval. We feel sure that when you see the surprising simplicity of this method you will agree with us that it is the greatest discovery ever made in this field.

Look it over, test it :t—then if after five days you decide that you want it, send us $5.00. If you do not wish to keep it, return to us and forget the matter.

But act AT ONCE. Learn to draw—whether or not your aim is commercial art. It is a big asset no matter which field you are in. Let us disclose to you the whole secret. Detach the coupon and mail TODAY.

Independent Corporation
Dept. D772, 319 Sixth Avenue, New York

Independent Corporation
Dept. D772, 319 Sixth Avenue, New York

You may send me the Course or Courses checked below. Within five days after receipt I will either remail them or send you $5 for each in full payment, except as noted.

- ☐ Drawing, Art Cartooning Course ($5) By Charles Lederer
- ☐ How to Read Character at Sight ($5) By Dr. K. M. H. Blackford
- ☐ Super-Salesmanship ($5). By A. Newcomb
- ☐ Roth Memory Course ($5) By David M. Roth
- ☐ Mastery of Speech ($5) By Frederick Houk Law
- ☐ Ferrin Home-Account System ($3.50) By Wesley W. Ferrin

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Address.....

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CONTENTS—*Continued*

MEDICINE AND SURGERY

MISCELLANY

(Continued on page 6)

A finer typewriter at a fair price

Over 900,000 sold

Don't Send One Cent

Our amazing free trial offer

Try the Oliver free before you buy. Send no money. Make no deposit. Mail only the coupon to get the Oliver for free trial.

Use the Oliver for five days as if it were your own. Put it to every test, to every comparison. Satisfy yourself that if any typewriter is worth $100 it is this superb Oliver with all its modern improvements.

If for any reason you decide that you don't want to keep the Oliver, just send it back at our expense (express collect). We even refund the outgoing transportation charges. So you can't lose a cent on the free trial. If you agree that it is the finest typewriter regardless of price, and want to keep it, take over a year to pay at the easy rate of only $4 a month.

Was $100 — **Before the War**

Now $64 — **You save $36**

You save $36 because you buy direct from the factory

A new Oliver nine, our latest and finest model, now only $64. The identical typewriter that sold for $100 before the war. Only our selling plan has changed, not the Oliver.

We now sell direct from factory to you. A sensible method, an economical method. We inaugurated this plan during the war, when economy was urged upon all of us as a patriotic duty. And we were glad to break away from the old system of selling typewriters. It was too complicated, too costly, too wasteful. It made the price too high.

We no longer have over 50 branch houses and sub-offices throughout the country. We save for you money that was going for high rents, employes' salaries, etc. We also save on traveling salesmen, whose salaries, commissions and road expenses had to be paid for in the price of the typewriter. Our new plan dispenses with these superfluous sales methods. The saving is $36, and it goes to you.

Other prices went up with the war—the Oliver came down

Note how other commodities have soared in price since the first days of the war. Nearly everything has doubled or trebled in price. But the Oliver sells for $36 less than before the war! That shows the economy of our maker-to-user plan.

Let others think that costly sales methods are necessary. As for us we are very well pleased with the Oliver plan. Our business has increased fourfold in the past three years. And today we are again adding to our manufacturing facilities.

Commodity Prices July, 1914 compared with Oct., 1920	
Breadstuffs—Increased	119%
Provisions—Increased	92%
Coal—Increased	241%
Textiles—Increased	103%
Fruits—Increased	142%
Oliver Typewriter—DECREASED	36%

Newest and finest Oliver

This is *not* a rebuilt or second-hand machine we offer. It is a new Oliver, latest model, and absolutely the finest product of our factory. It is the famous Oliver No. 9, the model that sold for $100 before the war. And you have the guarantee of a $2,000,000 company that it is the identical typewriter.

The Oliver is noted for its simplified and sturdy construction—for its freedom from trouble—for its year-in-and-year-out service and durability. It is distinguished for its handsome appearance, being richly furnished in nickel and olive green enamel.

Easy payments

Over a year to pay—Only $4 a month

If you decide to keep the Oliver after free trial, pay us at the easy rate of $4 a month.

This gives you over a year to pay, and you have the use of the typewriter while paying for it.

Think of it—payments so small as to average only about 13c a day! Our liberal payment plan makes it easy practically for everybody to own the Oliver typewriter.

Don't think of renting or buying a second-hand machine of doubtful quality when it is so easy for you to own the superb Oliver!

What great concerns think of the Oliver

National Suit & Cloak Co., New York: "In our business, typewriters are kept busy eight hours of every day. It is necessary that we use machines that are not alone speedy, but those that will stand up under such conditions. It was for these reasons that we installed the Oliver, and are now using over 500 of these machines, having standardized in them."

Nau, Rusk & Sevearingen Co., Cleveland: "Our typing is of great importance in our work as public accountants. It is highly necessary that we get clean-cut figures, a perfect register, and the best possible copies. That's why we use Oliver Typewriters. The Olivers are 'on the go' constantly in our office. The operators have no trouble with them and find them very simple to operate."

Tropical Paint & Oil Co., Cleveland: "We find that the Oliver Machines stand up for years—and during their life they give us complete satisfaction. The downward striking type-bar—a distinctive feature of the Oliver—insures perfect alignment, which is always a great advantage with a typewriter."

Among other prominent users of the Oliver are: Morris & Co.; New York Central Lines; Boston Elevated Railway; Hart, Schaffner & Marx; U. S. Steel Corporation, and others of great rank.

MAIL THE COUPON

The coupon brings you an Oliver for free trial. Mail it today.

If you wish further information before ordering, mark the coupon for our catalog and copy of our amazing booklet, "The High Cost of Typewriters—the Reason and the Remedy."

Avoid disappointment—order now to secure immediate delivery.

Canadian Price, $82

The OLIVER Typewriter Company

1102 Oliver Typewriter Bldg., Chicago, Ill.

THE OLIVER TYPEWRITER COMPANY
1102 Oliver Typewriter Bldg., Chicago, Ill.

☐ Ship me a new Oliver Nine for five days free inspection. If I keep it, I will pay $64 at the rate of $4 per month. The title to remain in you until fully paid for.

My shipping point is.....

This does not place me under any obligation to buy. If I choose to return the Oliver, I will ship it back at your expense at the end of five days.

☐ Do not send a machine until I order it. Mail me your book—"The High Cost of Typewriters—The Reason and the Remedy," your de luxe catalog and further information.

Name.....

Street Address.....

City.....*State*.....

Occupation or Business.....

CONTENTS—*Continued*

"MEN ONLY"

All Men READ THIS!

Every man, sometime in his life, has the problem before him: **"What Shall I Do for a Living?" "What Business Will I Follow?"** That is the question for all real red-blooded manhood to solve. All young men want to try their hand at what they like to do, to be their own boss, and to spend their own money, to say: "I made my own money"—not that Dad gave it or left it to me. Your Dad started out himself: He made good. **So can you,** if you will follow what you like.

If you like the farm, GET ONE! But learn how to run it scientifically. Run it by machinery and cut out the hard work. Now if you want to be an auto mechanic, Garage owner, Battery man, Vulcanizer, Tractor engineer, or to be a Certified auto mechanic, or if you want to own your own business, leave the farm to the boy who likes it, because all the WORLD will not make a farmer out of you. Men always SUCCEED at what they LIKE. This world is run by young men who want to be their own boss, who voted as they thought right, not as their fathers voted. That is American Manhood!

Young men mechanically inclined, made the automobile business what it is today. They run, build, repair eight million automobiles in the United States and make millions for themselves. I want to ask you a question. WHAT DO YOU LIKE TO DO BEST? WOULD YOU RATHER WORK ON MACHINERY THAN ANYTHING ELSE IN THE WORLD? ARE YOU MECHANICALLY INCLINED? If you are WRITE ME. I will tell you about men whom I have taught, who two years ago were shucking corn at three dollars a day. They are now business men, making from five hundred to a thousand dollars a month. Some of these were cow punchers, some clerks in a grocery store, some telegraph operators, in fact, they were from all lines of work, but they used their manhood and followed their mechanical inclinations and are today their own boss. I remember Harold Roberts, a farmer boy, 19 years old who two years ago, convinced his father that he did not like farming and his father was fair-minded enough to help the boy learn the right trade. ALL REAL fathers are very glad to help their boys if the boys will tell them what they want to do. Harold today is a business man in Illinois, making one thousand dollars a month. His Dad cannot do that well after thirty years' experience on the farm. Half the men in the world are misfits, working at something they do not like.

Maybe, you have always wanted to work on the automobile or gas engine but never had the chance. WRITE ME! I have solved the troubles of thirty thousand men. I have one million dollars invested in a building and equipment for you to use. I own the largest automobile school in the world and I am the "DADDY" of the business, although I am only 36 years of age. I have taught more men the automobile business than any other man in the world. Thousands of men have written to me, told me their ambitions, and have asked me to help them. Write me, tell me your ambitions. Do not waste your life, but be a LIVE ONE. BUCK UP! Get into business, one you are fitted for.

I have written a book on the Automobile and Tractor business, just like I am writing this, a good sensible talk, filled with facts, pictures, letters which tells and shows how other boys have made good and how I teach them to make good. I want you to tell me your real thoughts about the future. I am "E. J." to over thirty thousand men in the United States. I helped them. Write me now and you and I will figure it out together. Remember you are the one to earn your bread and butter. Why not make your work play by working at what you like. If you like machinery, if you are mechanically inclined, and are game, are not afraid of working in grease, gasoline, you and I will get along together fine. I cannot teach any man a trade if he does not like his work. If you don't like to work in the dirt, grease, among machinery, you are not mechanically inclined. If you are, write me, and write me NOW! Don't put it off, but get busy, get your pencil, fill out the coupon in the corner, and mail it to me for my book. This is the only school in the world where you can go into his office and call the president "E. J." and not get expelled from school. We have no professors. Our teachers are all real, red-blooded men who know their business, who teach the Sweeney System of training by using tools instead of books, and want to make it easy for you.

I had a student, Joel Piatt, who was deaf and dumb; I taught that boy his business and he is making a good living at it. That is how simple my system of teaching is.

This was the FIRST school the Government ever contracted with to teach students. I trained thousands of soldiers during the war. My school is a school ENDORSED BY ITS GRADUATES.

My school is a school where the teachers take an interest in you, and they make you feel at home. That is why my boys make good. When you graduate from the Sweeney School you are a "certified automobile mechanic" and no other school in the country confers this title. This is the proof that you know your business and are a TRAINED MAN.

Now I want you to sit down, get a pencil, fill out this coupon and write me personally, and I will answer you. Tell me your condition, about what you would like to do and I will help you all I can. Remember, you are your own boss and are held responsible for everything you do. If you are working at something you are not fitted for, you are doing yourself and your country an injustice.

MAKE A START RIGHT NOW!
WRITE ME AT ONCE!

Yours very truly,

Emory J. Sweeney, Pres.
SWEENEY AUTOMOBILE AND TRACTOR SCHOOL

LEARN A TRADE—Sweeney
SCHOOL OF AUTO-TRACTOR-AVIATION
829 SWEENEY BLDG. KANSAS CITY, MO

EMORY J. SWEENEY, President
829 Sweeney Bldg., Kansas City, Mo.

Send me free your 72-page catalog and Sweeney School News and tell me of the opportunities in the auto and tractor business.

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P. O.....

State.....

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AUTOMOBILE Parts for all cars—50% off manufacturers list price. Pistons, connecting rods, cam shafts, crank shafts, cylinders, axles and gears. Our new catalogue and Used Parts Bulletin now ready. Write for it to-day. Service and satisfaction guaranteed. Auto Parts Company, 4108 Olive Street, St. Louis, Missouri.

PATENTS—Write for Free Illustrated Guide Book and Evidence of Conception Blank. Send model or sketch and description of invention for our opinion of its patentable nature. Highest references. Reasonable terms. Victor J. Evans & Company, 189 Ninth, Washington, D. C.

BLUEPRINTS—Automobile generator armatures. See ad under "Electrical." Charles Chittenden.

DON'T lose your auto. Auto Theft Alarm, patent pending, gives continuous alarm if your auto is driven or towed away. Independent of ignition or car mechanism. Make one yourself easily from odds and ends. Licensed drawing and instructions $1.00. Adelson, 3238 (B) Douglas Boulevard, Chicago, Illinois.

SPEEDSTER and Racing bodies. Build your own—save over half. Floege's System of Auto-Body Building Dept. D, North Chicago, Illinois.

INSYDE Tyres, inner armor for automobile tires. Prevents punctures and blowouts; doubles mileage of any tires. Liberal profits. Details free. American Accessories Co., Dept. T-1762, Cincinnati, Ohio.

WHAT do you need? We have it. Gray's Auto Parts Company, 3212 Brighton Road, Pittsburgh, Pennsylvania.

AUTOMOBILE owners, repairmen and garagemen, send address to-day for free sample copy of American Automobile Digest, containing helpful, instructive information on overhauling, ignition troubles, carburetor efficiency, engine knocks, wiring, storage batteries simplified, etc. Clearly explained, profusely illustrated. American Automobile Digest, 523 Butler Building, Cincinnati.

FORD ACCESSORIES

FORDS start easy in cold weather. Will run 34 miles per gallon on cheapest gasoline or half kerosene, using our 1920 carburetors. Increased power; styles for all motors; can attach them yourself. Big profits to agents; money back guarantee; 30 days trial; Air Friction Carburetor Co., 1508 Madison Street, Dayton, Ohio.

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SMALL Motors and Generators, ⅛ h. p. a. c. $26.50, ⅕ h. p. $38.50, ¾ h. p. a. c. $67.50. Battery charging sets. Charging, lighting and moving picture arc generators. Motors for all phases of current. Prompt delivery. Wholesale prices. Write for late catalog. Address Motor Sales Dept. (14), West End, Pittsburgh, Pennsylvania.

ELECTRIC Motors. 500 heavy duty ¼ H. P. motors. General Electric and other standard makes. 110 volt, 60 cycle, single phase. Brand new, never unpacked. Guaranteed perfect. $20.00 and $26.00. Pennsylvania Motor Exchange, Lancaster, Pennsylvania.

9 inch and 11 inch screw cutting engine lathes with either bench or long legs. For attractive prices write South Bend Lathe Works, Madison Street, South Bend, Indiana.

ELECTRICAL

BLUEPRINTS—Electrical connections. Alternating and direct current motors, transformers, rheostats, controllers, compensators, automobile generator armatures. 10 samples A. C. 25c. Particulars free. Charles Chittenden, 83024 Matthews Avenue, Kansas City, Missouri.

ELECTRICIANS, Wiremen, Linemen, send your name and address for descriptive literature of our Modern Blue Print Chart Method of Electrical Wiring. Over 350 practical diagrams. Electrical Wiring Diagram Company, Box B173, Altoona, Pennsylvania.

ELECTRICIANS' time and contract blanks, estimate sheets, job tickets, etc., small or large lots, reasonable. Orders mailed day received. Samples free. Fink & Sons, Inc., Printers, Laurel Springs, New Jersey.

MR. ADVERTISER: Ask to-day for a copy of the "Quick-Action Advertising Rate Folder." If contains some really important facts which will prove interesting and valuable to you. It also tells "How You Can Use Popular Science Monthly Profitably." You'd like to know, wouldn't you? Manager Classified Advertising, Popular Science Monthly, 225 West 39th Street, New York.

WANTED

WANTED—Small gasoline and steam engines, electric drills, motors, etc. Will pay high cash prices for good material. Johnston, West End, Pittsburgh, Pennsylvania.

WANTED—Representatives in every Factory in the United States. Popular Science Monthly, 225 West 39th Street, New York.

MAIL Directly to the Refiners any old gold, silver, magneto points, old watches, diamonds, platinum, old or broken jewelry, false teeth, gold or silver ores or nuggets, war bonds and stamps. Send them to us today. Highest prices paid in cash by return mail. Goo is returned in ten days if you are not satisfied. The Ohio Smelting & Refining Company, 238 Lennox Building, Cleveland, Ohio.

A Few Facts Well Told!

Popular Science Monthly,
225 West 39th Street,
New York City.

Gentlemen:

Our advertisement in Popular Science Monthly has given such splendid results, that owing to our stock being fastly depleted through orders obtained through your medium, and our inability to secure tools fast enough, it will be necessary to cancel our notice until you hear from us further.

As soon as we can obtain deliveries from our factory we will reinstate our advertisement.

Appreciatively yours,

CHAS. E. TUCKER & SON.

This is a good letter and a splendid testimonial, but not an unusual one. Hundreds of such letters have been received from satisfied and successful advertisers in every part of America. They all tell the same story, "It Pays!" A trial test of YOUR advertisement would be more convincing, however, and would enable us to become acquainted. A request for rates and further information will receive prompt attention.

Classified Advertising Manager

POPULAR SCIENCE MONTHLY
225 West 39th Street
New York City

AVIATION

THE American School of Aviation announces a new correspondence course in Mechanics of Aviation. A thorough training in practical aeronautics. American School of Aviation, Dept. 1891, 3601 Michigan Avenue, Chicago.

AVIATION-MOTOR 30-40 H.P. 2 cyl. opposed air cooled, weight 128 lbs. ideal motor for light aeroplanes, motor sleds, wind wagons, hydroplanes, etc. Price only $325—complete with propeller ready to run. Aircraft Company, 338 Coney Island Avenue, Brooklyn, New York.

INVENTORS desiring information write for our Free Illustrated Guide Book and Evidence of Conception Blank. Send model or sketch of invention for our opinion of its patentable nature. Highest references. Prompt service. Reasonable terms. Victor J. Evans & Company, 151 Ninth, Washington, D. C.

PROPELLERS for air propulsion. 5 ft. diameter $12. Other sizes in proportion. Hub mountings, bearings, sprockets and countershafts complete. Full scale blue prints for motorcycle-driven snow and ice sleds, 75c. Ford type, $1. Crawford Motor and Aeroplane Mfgr., 142 South Rampart Street, New Orleans, Louisiana.

BUILD the Star Jr. Biplane. Send stamp for Circular "P." Chicago Aero Works, 326 River.

MANUFACTURING

LET us be your factory! Write us today. Logan Machine Company, 222 South Clinton Street, Chicago, Illinois

WE do Metal Stamping, Gold, Silver, Nickel, Brass and Copper finishing. We will manufacture your article either on time or contract basis. If interested in large production write us. When on your die work you are always welcome at our diemaker's bench. Denning Mfg. Company, 1775-1777 East 87th Street, Cleveland, Ohio.

MOTORCYCLES, BICYCLES, SUPPLIES

MOTORCYCLES $40.00 up; Side Cars, Evans Powercycles. Johnson Motor Wheels, and other light motor attachments. Send for our Big Bargain Bulletin and our "Money Saving Message to the Motorcyclist" (illustrated). It will save you money, on motorcycles, side cars, bicycles, repair parts, tires, and supplies. Our Repair Department is at your service. American Motor Cycle Company, Dept. 8, Chicago.

USED motorcycle parts half price. Schuck Cycle Company, 1922 Westlake, Seattle, Washington.

BOATS AND LAUNCHES

ENGINES at half price, stationary and marine, rebuilt like new. Guaranteed one year. 2 to 60 horsepower. Send for catalogue. Reliabuilt Motors Company, 296 Broadway, New York.

FORMULAS

500 successful money-making formulas and trade secrets, lists free; everything 25c. Edgar James, 315 Douglass, Indianapolis, Indiana.

1,000,000 FORMULAS. Trade secrets. 1016 pages $2. "Ideal," 5501-PS, North Robey, Chicago.

DON'T buy formulas till you've secured Miller's valuable Descriptive Lists advertised in Agents' Column this magazine. Miller, Industrial Chemist, Tampa, Florida.

SHOE Polish Formulas for sale. L. Allen, 566 Main Street, Brockton, Massachusetts.

LONDON Jack's stovepipe and chimney cleaner formula 25c. Charles Dynes, Winchester, Indiana.

MODELS AND MODEL SUPPLIES

PATENTS—Book free. Send sketch for free Opinion of patentable nature. Talbert & Talbert, 4848 Talbert Building, Washington, D. C.

WE make working models for inventors and do experimental work, and carry a complete stock of brass gears and model supplies. Send for catalogue. The Pierce Model Works, Tinley Park, Illinois.

MR. ADVERTISER: Ask to-day for a copy of the "Quick-Action Advertising Rate Folder." It contains some really important facts which will prove interesting and valuable to you. It also tells "How You Can Use Popular Science Monthly Profitably." You'd like to know, wouldn't you? Manager Classified Advertising, Popular Science Monthly, 225 West 39th Street, New York.

LABORATORY AND CHEMICAL SERVICE

HOW to make: dry cell, 10c; invisible ink, 15c. Toy electric motor 25c. Box 41, Hingham, Massachusetts.

PRACTICAL Chemical Laboratories. High-grade reasonably priced equipment for beginners and advanced experimenters. Descriptive literature and large chemistry catalogue, 10c. D. Altman Company, 223-225 East 110th Street, New York.

AMERICAN MADE TOYS

AN opportunity for homeworkers on small scale and manufacturers on large scale to make American Metal Toys. Army, Navy, Machine Guns, Cannons, Warships, Indians, Cowboys, Wild Animals, Whistles, Bird-whistles, Religious designs and other toys and Novelties. Greatest chance for industrious people to have an independent business. Enormous demand for cheap toys offers unlimited field and great future all over United States and foreign countries. Experience or tools not necessary. Hundred and more made complete per hour. Casting forms, complete outfit from $3.00 up. We buy these goods paying fixed prices. Attractive prices offered for painted goods. A strictly business proposition. No one need apply unless he means business. Booklet and information furnished free. We have no sales agents and we warn against worthless and cheap imitations. Toy Soldier Manufacturing Company, 1696 Boston Road, New York.

AUCTIONEERS

AUCTIONEERS and Bankers make big money. We teach both. Free catalog. Missouri Auction Banking School, Kansas City.

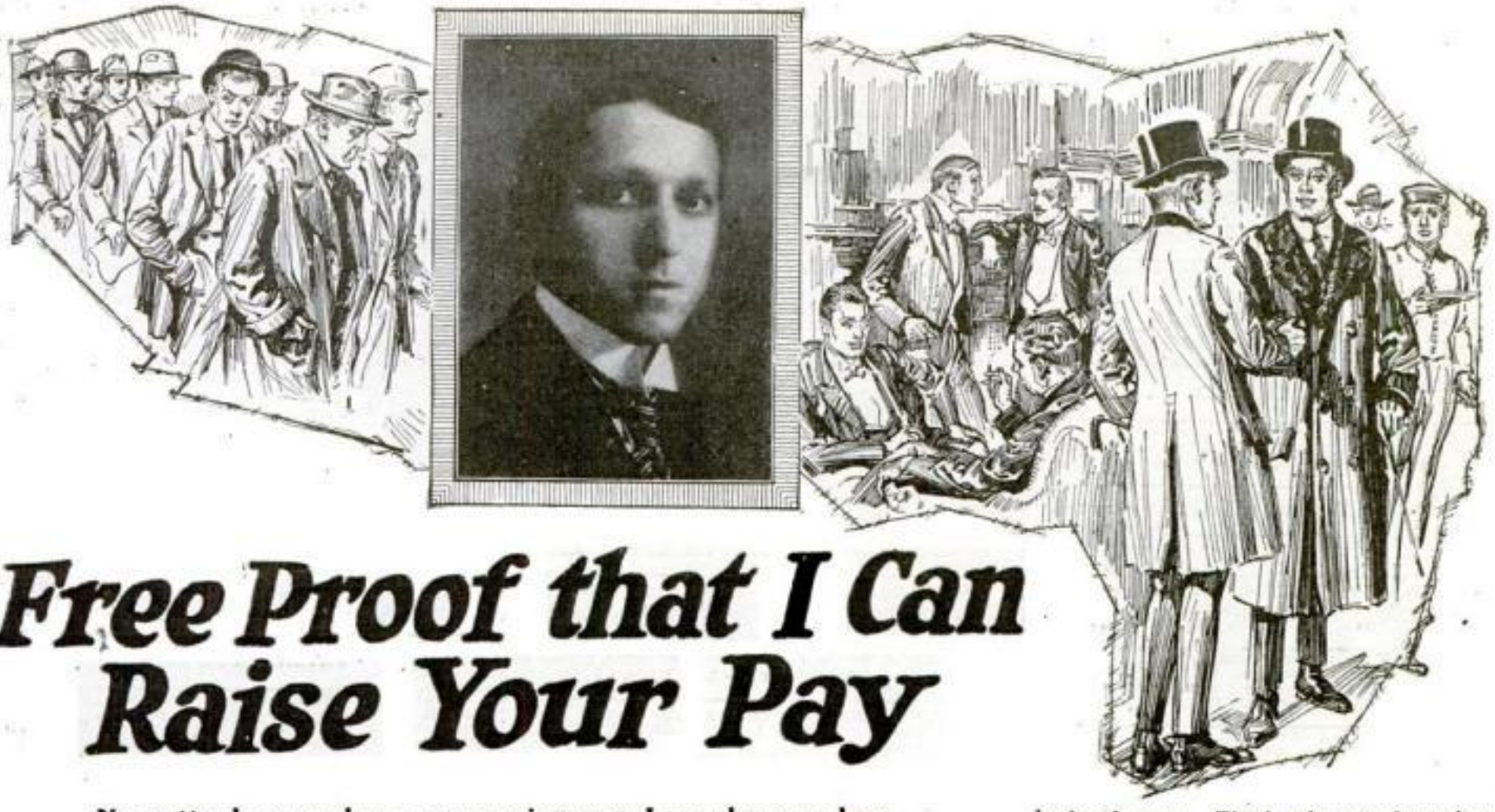
DUPLICATING DEVICES

OUR "Modern" Duplicator reproduces 50 to 75 duplicate copies from each pen, pencil or typewritten letter, drawing, pricelist, or anything. Saves you money. Need one? Letter size $6.50. Booklet free. J. V. Durkin, Reeves Company, Mfgrs., Pittsburgh, Pennsylvania.

FOR THE HOME

GRANDFATHER'S Clock Works $5.00. Build your own cases from our free instructions. Everybody wants a hall clock. You can make good profit building artistic clocks for your friends. We replace worn-out works in old clocks with works having chimes at money saving prices. Write for folder describing the most beautiful hall clock ever sold at $35.00. Clock Co., Nicetown, Pennsylvania.

Quick-Action Advertisements continued on page 10



Free Proof that I Can Raise Your Pay

No matter how much you are earning now, I can show you how to increase it. I have even taken failures and shown them how to make $100—$200, and in one case as high as $2,000 weekly. I am willing to prove this entirely at my risk and expense.

LET'S have a little chat about getting ahead—you and I. My name is Pelton. Lots of people call me "The Man Who Makes Men Rich." I don't deny it. I've done it for thousands of people—lifted them up from poverty to riches.

I'm no genius—far from it. I'm just a plain, everyday, unassuming sort of man. I know what poverty is. I've looked black despair in the eye—had failure stalk me around and hoodoo everything I did. I've known the bitterest kind of want.

But today all is different. I have money and all of the things that money will buy. I am rich also in the things that money won't buy—health, happiness and friendship. Few people have more of the blessings of the world than I.

IT was a simple thing that jumped me up from poverty to riches. As I've said, I'm no genius. But I had the good fortune to know a genius. One day this man told me a "secret." It had to do with getting ahead and growing rich. He had used it himself with remarkable results. He said that every wealthy man knew this "secret"—that is why he was rich.

I used the "secret." It surely had a good test. At that time I was flat broke. Worse than that, for I was several thousand dollars in the hole. I had about given up hope when I put the "secret" to work.

At first I couldn't believe my sudden change in fortune. Money actually flowed in on me. I was thrilled with a new sense of power. Things I couldn't do before became as easy for me to do as opening a door. My business boomed and continued to leap ahead at a rate that startled me. Prosperity became my partner. Since that day I've never known what it is to want for money, friendship, happiness, health or any of the good things of life.

That "secret" surely made me rich in every sense of the word.

MY sudden rise to riches naturally surprised others. One by one people came to me and asked me how I did it. I told them. And it worked for them as well as it did for me.

Some of the things this "secret" has done for people are astounding. I would hardly believe them if I hadn't seen them with my own eyes. Adding ten, twenty, thirty or forty dollars a week to a man's income is a mere nothing. That's merely playing at it. In one case I took a rank failure and in a few weeks had him earning as high as $2,000.00 a week. Listen to this:

A young man in the East had an article for which there was a nation-wide demand. For twelve years he "puttered around" with it, barely eking out a living. Today this young man is worth $200,000. He is building a $25,000 home—and paying cash for it. He has three automobiles. His children go to private schools. He goes hunting, fishing, traveling whenever the mood strikes him. His income is over a thousand dollars a week.

In a little town in New York lives a man who a few years ago was pitied by all who knew him. From the time he was 14 he had worked and slaved—and at sixty he was looked upon as a failure. Without work—in debt to his charitable friends, with an invalid son to support, the outlook was pitchy black.

Then he learned the "secret." In two weeks he was in business for himself. In three months his plant was working night and day to fill orders. During 1916 the profits were $20,000. During 1917 the profits ran close to $40,000. And this genial 64-year-young man is enjoying pleasures and comforts he little dreamed would ever be his.

I COULD tell you thousands of similar instances. But there's no need to do this as I'm willing to tell you the "secret" itself. Then you can put it to work and see what it will do for you.

I don't claim I can make you rich over night. Maybe I can—maybe I can't. Sometimes I have failures—everyone has. But I do claim that I can help 90 out of every 100 people if they will let me.

The point of it all, my friend, is that you are using only about one-tenth of that wonderful brain of yours. That's why you haven't won greater success. Throw the unused nine-tenths of your brain into action and you'll be amazed at the almost instantaneous results.

The Will is the motive power of the brain. Without a highly trained, inflexible will, a man has about as much chance of attaining success in life as a railway engine has of crossing the continent without steam. The biggest ideas have no value without will-power to "put them over." Yet the will, altho heretofore entirely neglected, can be trained into wonderful power like the brain or memory and by the very same method—intelligent exercise and use.

If you held your arm in a sling for two years it would become powerless to lift a feather from lack of use. The same is true of the Will—it becomes useless from lack of practice. Because we don't use our Wills—because we continually bow to circumstances—we become unable to assert ourselves. What our wills need is practice.

Develop your will-power and money will flow in on you. Rich opportunities will open up for you. Driving energy you never dreamed you had will manifest itself. You will thrill with a new power—a power that nothing can resist. You'll have an influence over people that you never thought possible. Success—in whatever form you want it—will come as easy as failure came before. And those are only a few of the things the "secret" will do for you. The "secret" is fully explained in the wonderful book "Power of Will."

A Few Examples

Personal Experiences

Among the 400,000 users of "Power of Will" are such men as Judge Ben B. Lindsey; Supreme Court Justice Parker; Wu Ting Fang, Ex-U. S. Chinese Ambassador; Assistant Postmaster General Britt; Gov. McKelvie of Nebraska; General Manager Christeson of Wells-Fargo Express Co.; E. St. Elmo Lewis, former Vice-Pres. Art Metal Construction Co.; Gov. Ferris of Michigan; and many others of equal prominence.

$300 Profit from One Day's Reading

"The result of one day's study netted me $300 in cash. I think it a great book and would not be without it for ten times the cost."—Col. A. W. Wilkie, Roscoe, So. Dakota.

Worth $15,000 and More

"The book has been worth more than $15,000 to me."—Oscar B. Sheppard.

Would Be Worth $100,000

"If I only had it when I was 20 years old, I would be worth $100,000 today. It is worth a hundred times the price."—S. W. Taylor, the Sante Fe Ry., Milans, Texas.

Salary Jumped from $150 to $800

"Since I read Power of Will my salary has jumped from $150 to $800 a month."—J. F. Gibson, San Diego, Cal.

From $100 to $3,000 a Month

"One of our boys who read Power of Will before he came over here jumped from $100 a month to $3,000 the first month, and won a $250 prize for the best salesmanship in the state."—Private Leslie A. Still, A. E. F., France.

How You Can Prove This at My Expense

I KNOW you'll think that I've claimed a lot. Perhaps you think there must be a catch somewhere. But here is my offer. You can easily make thousands—you can't lose a penny

Send no money—no, not one cent. Merely clip the coupon and mail it to me. By return mail you'll receive not a pamphlet, but the whole "secret" told in this wonderful book "POWER OF WILL."

Keep it five days. Look it over in your home. Apply some of its simple teachings. If it doesn't show you how you can increase your income many times over—just as it has for thousands of others—mail the book back. You will be out nothing.

But if you feel that "POWER OF WILL" will do for you what it has done for over four hundred thousand others—if you feel as they do that it's the next greatest book to the Bible—send me only $4.00 and you and I'll be square.

If you pass this offer by, I'll be out only the small profit on a $4.00 sale. But you—you may easily be out the difference between what you're making now and an income several times as great. So you see you've a lot—a whole lot—more to lose than I.

Mail the coupon or write a letter now—you may never read this offer again.

Pelton Publishing Company

14-B Wilcox Block **Meriden, Conn.**

Pelton Publishing Company
14-B Wilcox Block, Meriden, Conn.

You may send me "Power of Will" at your risk. I agree to remit $4.00 or remail the book to you in five days.

Name.....

Address.....

ADDING MACHINES

DON'T get stung! Send no money! Marvelous Automatic Calculating Machine on free trial. Adds, subtracts, multiplies, divides. Lightning speed. Errors impossible. Work equals $350 machine. Retails $15 with desk stand. Written five-year guarantee. Write quick for amazing free offer. Calculator Company, Grand Rapids, Michigan.

THE SESAME adds to 9,999,999. 25c. B10. Taylors Falls, Minnesota.

COLLECTIONS AND ADJUSTMENTS

ENUF said—Creditors' Bureau, 217 Parkway Building, Philadelphia.

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MISCELLANEOUS

5 MASTER KEYS, $1.00. Opens hundreds of different locks. The world's most wonderful set of keys. Master Key Company, 34 Manhattan Building, Milwaukee, Wisconsin.

ELECTRICAL Tattooing Machine, $3, $5, and $7. Catalogue for stamps. J. H. Temke, 1019 Vine, Pam., Cincinnati, Ohio.

IMMUNITY from infection. Use L-Wood Sanitary coverings for closet seats. Package containing 6, 15c postpaid. L-Wood, 460 Madison Avenue, Albany, New York.

HARDWOOD - FLOORS — Clean — renovate and refinish—your own floors. Instructions and formulas tell how, also care of floors. Price $1.00. Post Office Box 775B, Chicago, Illinois.

GLASS SIGNS for rooms, furnished rooms, boarding, dress-making, cafes, restaurants, banks, offices, door name plates, house numbers, glass signs made to order. Write for price list. Penn Glass Sign Company, Fort Smith, Arkansas.

BEAUTIFUL flowers—Profitable gardens. Use our paper pots. Transplant without injury. Avoid cutworms. Booklet free. Peerless Mfg. Co., Box 81, Goodrich St. Station, Akron, Ohio.

FREEBURN artist, Hicksville, Ohio. Help beginners in drawing, lettering, cartooning. Write him.

EVERSHARP Pencils and leads 25c by mail. U. S. Pencil Company, Capital Bank Building, St. Paul, Minnesota.

STAMPING NAMES

MAKE $19.00 Hundred Stamping Names on Key Checks. Send 25c for sample and instructions. PS Keytag Company, Cohoes, New York.

TELEGRAPHY

TELEGRAPHY (both Morse and Wireless) and Railway Accounting taught quickly. Tremendous demand. Big salaries. Great opportunities. Oldest and largest school; established 46 years. All expenses low—can earn large part. Catalog free. Dodge's Institute, K Street, Valparaiso, Indiana.

TELEGHAPHY—Morse and Wireless—taught at home in half usual time and at trifling cost. Omnigraph Automatic Transmitter will send, on Sounder or Buzzer, unlimited messages, any speed, just as expert operator would. Adopted by United States Government and used by leading Universities, Colleges, Technical and Telegraph Schools throughout United States. Catalog free. Omnigraph Mfg. Company, Dept. 42, 26 Cortlandt Street, New York.

STAMMERING

STAMMERERS: My simple and natural method will correct your impediments. Instruction individual. Samuel E. Robbins, 246 Huntington Avenue, Boston.

ST-TUT-T-T-TERING and Stammering cured at home. Instructive booklet free. Walter McDonnell, 59 Potomac Bank Building, Washington, D. C.

LETTER SPECIALISTS

LETTERS of individuality, dividend producers, forceful and convincing. Mackey, 217 Parkway Building, Philadelphia.

LETTER WRIT'NG

THE Secret of Writing Successful Letters revealed to you by Ad-Man Davison, the highest-paid letter writer in the world. Wonderful 976-page instruction course, including 500 successful letters. For Free Booklet address Desk 60, Opportunity Press, 681 Fifth Avenue, New York.

ADVERTISING SERVICE

ADVERTISING prepared and placed in any publication. Letters, circulars, booklets written, illustrated and printed. Douglas Wakefield Coutlee, 1A West 34th Street, New York.

SPECIAL!!! Inch Display advertisement 150 Magazines thrice $15. Page $200. Globe Syndicate, Atlantic City.

BETTER results for less money. Stanford Rate Bulletin, giving rates leading publications, free. A complete service. Stanford Service, Lancaster, Pennsylvania.

24 words in 20 Iowa papers $8.00. Big results. Get bulletin listing 707 dailies. Desk one, Climax Advertising Agency, Clinton, Iowa.

RICHARDSON'S Agency writes sane, sensible advertising. Folder free. Evanston, Illinois.

ADVERTISE in 100 Magazines. Words 9c each; three times 18c each. Concordia Magazine, 2D Water, York, Pennsylvania.

WANT agents, salesmen, canvassers, mail buyers. Sell the Canadian market. 50 words in Five Syndicate Monthlies, $2.00. Displayed inch $3.00. Lasnier Advertising Agency, Dept. PSM, Bathurst, N. B., Canada.

SALES Problems Solved. Complete facilities for marketing your article at a profit. Evans & Dubes, Fairbanks Building, Springfield, Ohio.

ADVERTISE in 24 big Iowa dailies, 25 words $10.00; "They Pull." Advertisers Guide free. Union Advertising, Baltimore Building, Chicago.

18 WORDS in 100 Magazines, $1.00. Lists free. Stanford Corporation, Lancaster, Pennsylvania.

PRINTING, ENGRAVING, MULTIGRAPHING

833 FT. LABELS, $2.50. Save 30% on all. Wolf Labels, Station E, Philadelphia.

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LETTERHEADS $2.50 thousand. Samples free. Quality Print Shop, Marietta, Ohio.

GOOD Printing Reasonable. Machine composition, automatic printing presses, automatic envelope machinery. We print anything. Get our prices. A. H. Kraus, Kraus Building, Milwaukee, Wisconsin.

CITY printing at country prices. Write for samples and prices. Royal Printing Company, Sugarcreek, Ohio.

SUPERIOR printing for less money. Samples free. Economic Printery, Leonia, New Jersey.

BETTER printing for less money! Send for our large package of samples of hundreds of items every user of printing is interested in. These samples worth dollars will be sent for 10 cents to pay postage. Ernest Fantus Company, 525 South Dearborn Street, Chicago.

ENGRAVED stationery at 60% saving. Plates unnecessary. Cards Letterheads, Announcements, etc. Samples sent. Alden Non-Plate Engraving Company, 15 Avon Street, Boston, Massachusetts.

PRINTING—Multigraphing—quick service, quality work, low prices. Mazon Service, Box 613-S, Waterloo, Iowa.

GUMMED labels! Interesting samples free! Edward Harrison, "Artistic Stickers," Baltimore.

MULTIGRAPH Letters build business. Most economical and effective advertising. Printing. Addressing. Low rates; careful work; service. Multigraph-Peerless Letter Company, 241 Fourth Avenue, New York.

100 CARDS, business, professional, or social, card-case free, 75 cents. Agents wanted. G. B. Pratt, 68 Madison Street, Cortland, New York.

MULTIGRAPHED letters, two color printed letterheads, thousand complete, 1c each delivered. Griffith, 4317 Madison, Chicago.

OFFICE AND FACTORY EQUIPMENT

MULTIGRAPHS, Duplicators, Addressing, Folding, Sealing Machines. Bought, Sold and Rebuilt. Guaranteed. Office Device Company, 154A, West Randolph, Chicago.

MULTIGRAPHS, Addressographs, Duplicators, Sealers, Folders, less than half price. Guaranteed one year. Pruitt Company, 112-M North La Salle, Chicago.

ADDRESSOGRAPHS, Multigraphs, Duplicators, Folders, Sealers, Bought, Sold with Guarantee. Office Device Exchange, 503 Baltimore Building, Chicago.

TYPEWRITERS AND SUPPLIES

RE-MANUFACTURED typewriters at reduced prices. Shipped for 5 days' trial. Write for our Catalog No. 25 and save money. Beran Typewriter Company, 58 West Washington Street, Chicago.

TYPEWRITER delivered free—rented—sold on payments. Galbreath Typewriter Company, Rogers, Ohio.

POULTRY AND LIVE STOCK

RAISE poultry and rabbits—we tell how. Great rabbit book, 25c. Paper $1.00 year; both $1.15. Sample free. Poultry Advocate, Dept. B-42, Syracuse, New York.

DOGS, BIRDS, PETS

WHITE collies, beautiful, intelligent and useful. The Shomont, Monticello, Iowa.

GERMAN Shepherd, Airedales, Collies, Old English Shepherd dogs, brood matrons, puppies, farm helpers, 10c for instructive list. W. R. Watson, Box 225, Oakland, Iowa.

REGISTERED Airedales. Best imported, American breeding, $15, $35. J. W. Carnagey, Belton, Missouri.

FOR MEN AND WOMEN

MEN or Women—Enormous Profits Selling Duo Guaranteed Products. Easy sales at every house. All or spare time. Outfit free. Write quick. Duo Company, Dept. H66, Attica, New York.

BE a detective. Excellent opportunity, good pay, travel. Write C. T. Ludwig, 424 Westover Bldg., Kansas City, Missouri.

GENUINE Indian Baskets—Wholesale. Catalogue Gilham, Highland Spring, California.

START oilpainting portrait, photo and enlargement studio in your home. We guarantee teach you to oil paint portraits without brushes. Beautiful work. No experience, capital or apparatus necessary. Outfit furnished. Free booklet. Start a branch Tangley Studio and make $5,000 yearly. Tangley, 110 Main, Muscatine, Iowa.

"SEXUAL Philosophy," 12c. Clear, specific, authoritative, complete, best, satisfies. Fred B. Kaessmann, Lawrence, Massachusetts.

DETECTIVES—Excellent opportunity. Fascinating work. Experience unnecessary. Particulars free. Write. American Detective System, 1968 Broadway, New York.

SEX books for advanced adult students and professionals. The most authoritative sex books including Kisch, Forel, Krafft-Ebing, etc. Send for list. Modern Book Society, 5 Hanson Place, Brooklyn, New York City, Desk 16.

PICTURES AND POSTCARDS

EVERYTHING in postcards. Live-wire list free. Worth-while samples 25c. Mention subjects preferred. Mutual Supply Company, Bradford, Pennsylvania.

JOIN Live Postcard Club. Membership Papers 10c Harvey Teeple, Decatur, Indiana.

SPECIAL—Twenty clever, classy, assorted postcards 10c, prepaid. Swanson, 12058 Kansas Avenue, Kansas City, Kansas.

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EDUCATIONAL AND INSTRUCTION

LINCOLN-JEFFERSON University, Home study in College, Theological, Law, Music, Pharmacy, Business and Graduate Schools. Leading to degrees. Lock Box 239G, Chicago.

SPANISH—Spontaneous Method. You and I exchange letter in Spanish every day. Inexpensive. Particulars free. Guillermo Hedin, 3509 Franklin Avenue, St. Louis, Missouri.

MY simplified course makes you a fine writer. Send quarter for your signature twelve styles. Meub, Expert Penman, High School, Pasadena, California.

PLUMBERS and Heating Men thinking of going into business for themselves soon, can hasten that time by sending at once to Niebuhrs Plumbing Business Bureau, 105 Fifth Street, La Crosse, Wisconsin, for confidential information regarding financing, accounting, estimating, etc.

ARITHMETIC for shopmen, machinists, carpenters, builders and contractors, $5.00. Test lesson, 5 problems worked out 25 cents. Engineering Institute, 357 West 63rd Street, Chicago.

OVER 100 home study courses thoroughly taught by mail. Address Carnegie College, Rogers, Ohio.

LEARN Piano-playing by Ear in four lessons. Complete course, $1.00. Results guaranteed. Sterling System Studios, Mt. Joy, Pennsylvania.

DOUBLE entry bookkeeping mastered in 60 hours with 8 keys; guaranteed; diplomas. International Bookkeeping Institute, Dept. 7, Springfield, Missouri.

LISTEN! To Earn More, Learn More! Used Correspondence Courses and Educational Sets sold. (Courses and sets bought.) Write to-day! Now! Moorehead's, 2670 Bush Street, San Francisco, California.

AUTHORSHIP—Cartooning. Author's Manual teaches writing; illustrating. "How—where sold." Complete instructions $1.00. Thoreo, 2134 Kent, Los Angeles, California

VALUABLE lessons in entertaining and a set of first-class stories, parodies, monologues, etc., for only $1.00. P. A. Service Bureau, 20 East Jackson Boulevard, Chicago.

PATENTS FOR SALE

WRAPPING tool for binding wire onto hose. Most efficient tool on the market for the purpose. Write for description and model, big field. Sell cheap. Patent No. 1266002. Wm. S. Downing, Houghton, Michigan.

WE have a few practical money-making inventions for sale or trade. Adam Fisher Mfg. Co., 183B, St. Louis, Missouri.

NEW legless ironing board. Entire rights, $2,000. Cato, 231 South Sixth, Springfield, Illinois.

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GAMES AND ENTERTAINMENT

FOUR Magic Catalogs and Samples—15c. Gilmagico, Morgan Park, Illinois.

CHALK TALK, illustrated in colors. Fine rag pictures. Lecture for pictures. Price $1.00. R. H. Johnson, 4514 South 20th Street, Omaha, Nebraska.

TRICKS, Escapes, Puzzles, Photos, Books. Catalogue free. Magicraft Co., Dept. E., Box 251, Detroit, Michigan.

MAGIC—Tricks, Jokes, Books, Pictures, Etc. Big catalog for stamp. United Sales Co., Springfield, Illinois.

TRICKS, Puzzles, Jokes, Plays, Wigs, Mind Reading Acts and Sensational Escapes. Send stamp for catalogue. Oaks Magical Company, Dept. 400, Oshkosh, Wisconsin.

PLAYS, vaudeville acts, monologs, dialogs, recitations, pageants, musical readings, special entertainments, tableaux, drills, minstrel jokes, make-up goods. Large Catalog free. T. S. Denison & Company, Dept. 26, Chicago.

125 CARD Tricks, and how to do them. 25c. United Sales Co., Springfield, Illinois.

BOYS make a model aeroplane that will fly. Easily made at small cost. Write for circular. Aero Shop, 658½ Huribut Avenue, Detroit, Michigan

GAMES, puzzles, magic tricks, books. Catalogue free. Pastime Circle, St. Louis, Missouri

PHOTOGRAPHY AND SUPPLIES

FILMS developed 5c roll, prints 3c each. Photo Service, 929 McMillan, Cincinnati, Ohio.

DISABLED Soldiers Photo Company, 3654 North Halsted Street, Chicago. Films developed 7c. Trial prints 3c. Post cards, 5c. Work guaranteed.

SAMPLE enlargement, dime and negative (returned). Roll developed and six prints 25c. silver. Brown Studio, Lake Elmo, Minnesota.

MAKE $75 weekly with your Kodak or Camera. Write Thomas Manufacturing Company, 122 Greenwich Avenue, New York, New York.

PRINTS 2½c up. Send for price list. Blad, Wareham, Massachusetts.

TRIAL offer—roll developed, six prints, enlargement for 25c silver with order. Alves Photo Shop, Braintree, Massachusetts.

SEND favorite negative for sample enlargement offer and price list, negative returned. Western Portrait Company, 2118 Kendall Street Chicago, Illinois. Dept. 15J.

MAIL us 20c with any size film for development and six velvet prints. Or send six negatives any size and 20c for six prints. Or send 40c for one 8x10 mounted enlargement. Prompt, perfect service. Roanoke Photo Finishing Company, 212 Bell Avenue, Roanoke, Virginia.

SPECIAL offer—Your next Kodak film developed 10c., and first six prints 2c each. 24 hours service. Enclose money with order. Write for price list "3" and sample print. Johnston & Tunick, 53 Nassau Street, New York.

MUSICAL INSTRUMENTS

VIOLINS—Deep, Mellow, Soulful—on credit. Easy terms for wonderful instrument. Get details to-day. Gustav L. Henning, 2424 Gaylord Street, Denver, Colorado.

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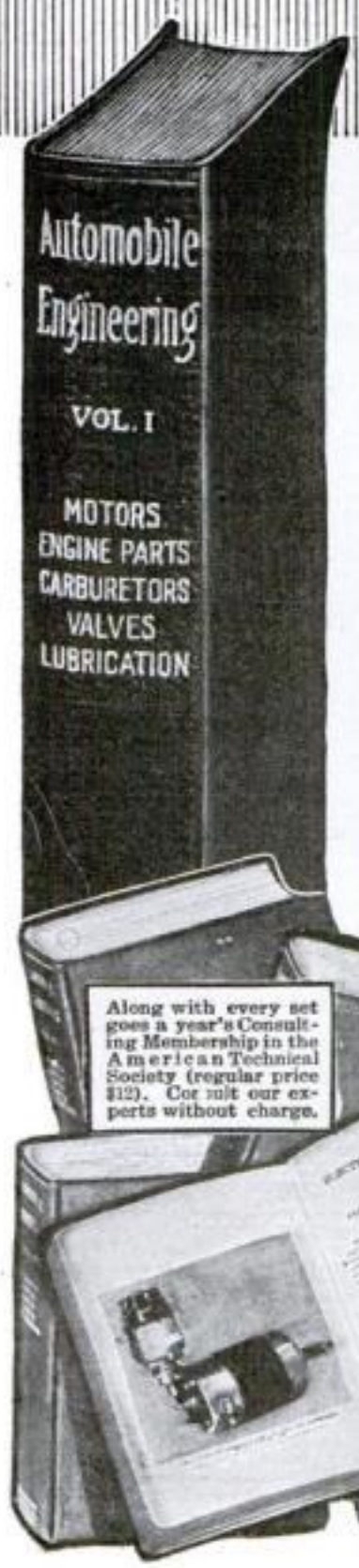
Here's YOUR CHANCE!

Reduced in Price



Partial List of Contents:

- Automobile Motors
- Welding
- Motor Construction and Repair
- Carburetors and Settings
- Valves, Cooling
- Lubrication
- Fly Wheels
- Clutch
- Transmission
- Final Drive
- Steering Frames
- Tires
- Vulcanizing
- Ignition
- Starting and Lighting Systems
- Shop Kinks
- Commercial Garage
- Design and Equipment
- Electrics
- Storage Batteries
- Care and Repair of Motorcycles
- Commercial Trucks
- Gas Tractors

128 Blueprints of Electric Wiring Diagrams

Why Do'nt You Earn BIG MONEY?

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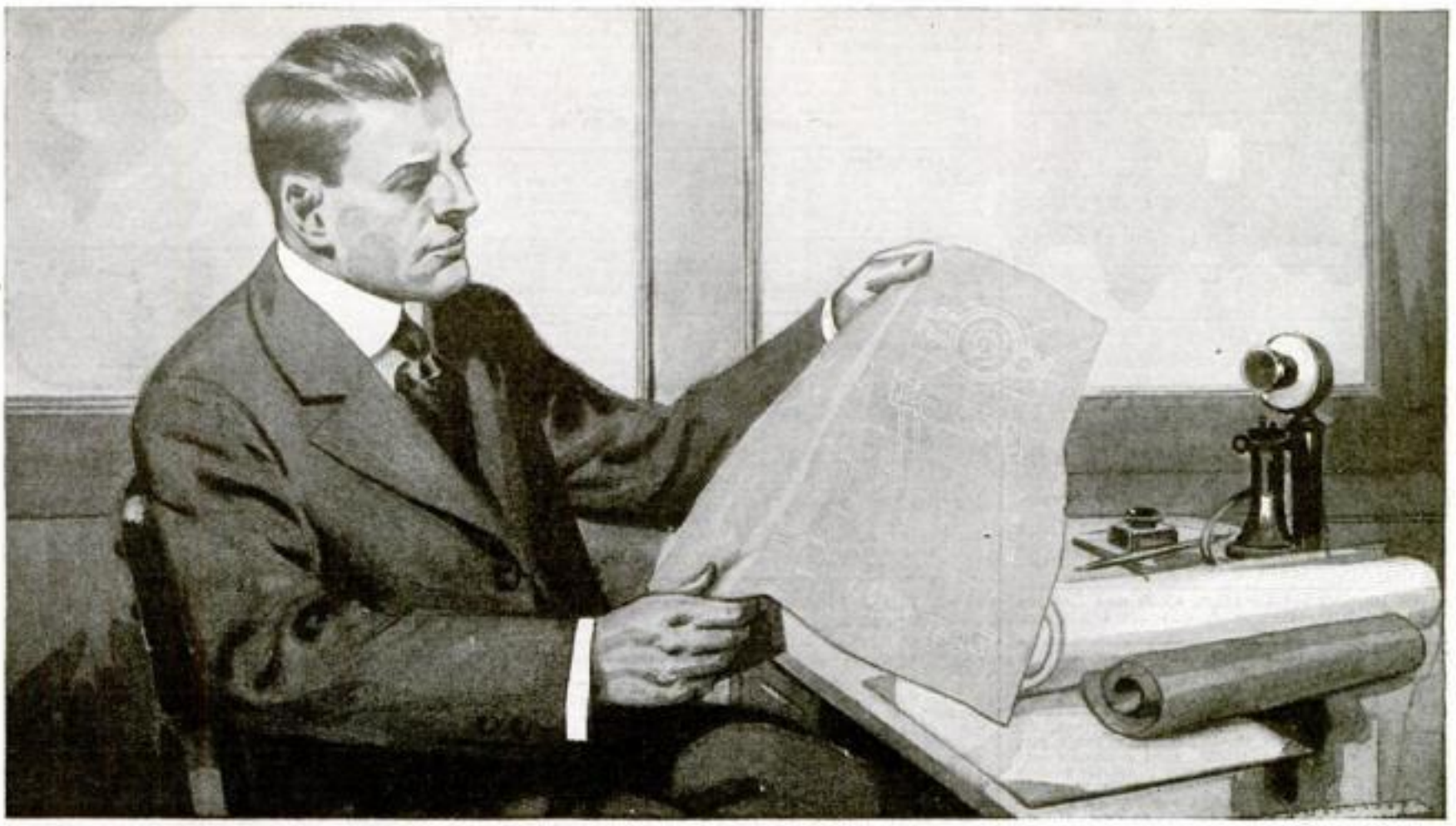

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REAL, honest proposition. Guaranteed. Big money, easy quick sales. Newest, best Safety Razor on market. Retails $1.00. Standard Safety Razor Corp., Pittsburgh Pennsylvania.

AGENTS—Cash in on Prohibition. $43 to $58 weekly; new fast-selling articles going like wildfire; agents cleaning up; write to-day for particulars. American Products Company, 3147 American Building, Cincinnati, Ohio.

MAKE $50 daily. Something new! 400% profit. All business, professional men need it. Sells $5. Costs $1. Brooks, Texas, sold 20 first day, profit $80. Big weekly repeater. Sells quickly. Experience unnecessary. Write to-day for territory wanted. Sample outfit free. Federal Association, Hartford, Connecticut.

AGENTS: We pay $6 a day taking orders for New Kerogas Burner. Fits any stove. Burns coal oil. No experience or capital required. Work spare time or full time. Write for demonstrating sample. Thomas Mfg. Co., Class 2661, Dayton, Ohio.

AGENTS make big money because sales may be made in every home. Our modern aids to home sanitation have an appeal that cannot be resisted. A brush, mop or duster for every need. Liberal commissions and good territory. North Ridge Brush Company, 136 Clark Street, Freeport, Illinois.

STOP here: Make $30 next Saturday. Agents, salesmen, district managers, brand new invention—selling like wildfire. Sell Speederators for Fords. Makes any Ford run like a Packard. Stops stalling and bucking. Put on quick—no tools nor holes to bore. Instant satisfaction. Listen—make money quick—$75 to $150 week easy. Helton, Utah, makes $300 every week. McAllister, Illinois, made $12 first afternoon. Dane, West Virginia, $55 a week spare time only. Hurry, write quick for details and exclusive territory. Address Perrin Company, 1085 Hayward Building, Detroit, Michigan.

WE pay $200 monthly salary and furnish rig and expenses to introduce guaranteed poultry and stock powders. Bigler Company, X371 Springfield, Illinois.

$6000.00 A YEAR is your profit from 4 sales a day. Davidson sold 96 one week. No experience needed. The Aladdin light is a sensation wherever introduced. 5 times as bright as electric. Won Gold Medal. Farmers have the money, they need this light and 9 out of 10 will buy. Also big opportunity in small towns and suburbs. Excellent spare time and evening seller. No capital required. Sample on free trial. Write for agency proposition while territory still open. Mantle Lamp Company, 524 Aladdin Building, Chicago.

$15.00 DAILY selling the New Amberoid Unbreakable Combs; kind you can hit with a hammer; write for wholesale prices. J. Bucknam, Box 2792, Boston, Massachusetts.

$1,000 per Man per County; Strange invention startles world—agents amazed. Ten inexperienced men divide $40,000. Kerstad, a farmer, did $2,200 in 14 days. Sleicher, a minister, $195 first 12 hours. $1,200 cold cash, made paid, banked by Stoneman, in 30 days; $15,000 to date. A hot or cold running water bath, equipped for any home at only $7.50. Self-heating. No plumbing or water-works required. Investigate. Exclusive sale. Credit given. Send no money. Write letter or postal to-day. Allen Mfg. Co., 589 Allen Building, Toledo, Ohio.

GET our plan for monogramming automobiles, trucks, hand luggage and all similar articles by transfer method; experience unnecessary; exceptional profits. Motorists Accessories Company, Mansfield, Ohio.

SALESMEN sell Protex Intires. New invention prevents punctures and blowouts. Every automobile tire user ready buyer. Big side line for tire salesmen. Protex Company, 176 Livingston Street, Brooklyn, New York.

GREAT opportunity to start 1921 right. Sell motor mica anti-friction lubricate. Never fails to cool a hot bearing. Needed in every manufacturing plant. Write for samples and particulars. Motor Mica Products Company, Chicago, Illinois.

SALES Agents (District) wanted to distribute new automatic Tire Pressure Regulator. Must have some capital and be capable of organizing territory through sub-agents. Territory arranged. Exceptional profits. Write: Webber & Doyle, Inc., Beverly, Massachusetts.

AGENTS—Koal Save; new, scientific, chemical discovery amazes nation; saves one third coal bill; not a mechanical device; burned with coal; agent's success astounding; $500 monthly easily; coal scarce, price high; possibilities tremendous; exclusive territory. Koal Save Company, Dept. 17, 189 N. Clark, Chicago.

FULL or part time salesmen; commission. Mitchell, Wholesale Hardware, Aurora, Illinois.

MAKE $5.00 hour selling "Columbus Raincoats" to your friends. Miller made $30.00 first day spare time. Big profits. Sample free. Act quick! Columbus Raincoat Mfg. Company, Dept. 524, Columbus, Ohio.

SALESMEN—Agents—Every man and boy a customer. Big profits. Samples and information postpaid, 50c. Peerless Products Company, 4821 Lexington Avenue, Cleveland, Ohio.

U. S. Player Rolls have been nationally known for fifteen years; five thousand music dealers sell them. Honest and energetic people can become our representatives where we have no dealers. Big profits—no investment required. United States Music Company, 2933 West Lake Street, Chicago, Illinois.

STRETCHING cuff buttons, cuffs may be raised over elbows—instantly without bother. Durable, neat, no competition, sells like wildfire everywhere. Liberal bonafide proposition for real live salespeople everywhere. Expandolinks, Sheboygan, Wisconsin.

AMAZING invention. Burner for cookstoves. Converts kerosene into combustible gas. Blue flame, gravity feed. Agents coining money. Season on. Exclusive territory. Vapor Gas Burner Company, Desk 4, Columbus, Ohio.

AGENTS. Spark Intensifier Transformer. All Cars. More Pep. Less Gas. Large Profits. Get our prices. Automote Manufacturing Company, 2246 North Central Park, Chicago.

SALESMEN—Side or main line, to sell low-priced 6,000 mile guaranteed automobile tires, 30x3½ non-skid sells for $13.95; other sizes in proportion. Good money-making proposition for live wires. Master Tire Co., 1414 South Michigan, Chicago.

BEGINNERS' complete mail order system. PS., Box 1005, Atlantic City, New Jersey.

GET our plan for selling Arion Phonographs at home. No canvassing. Quality equal to high priced instruments sold in stores. Low price gets you the business—quality builds more business for you. Big profits. Write to-day. Arion Phonograph Company, 1212 Arion Building, Elkhart, Indiana.

56 MILES per gallon made with Ford. One sample free. Vaporizer Company, 96 Pukwana, South Dakota.

AGENTS—Make $50 weekly taking orders for fast-selling Goodyear raincoats; hundreds of orders waiting; $2 an hour for spare time; we deliver and collect. Write to-day for agency. Goodyear Mfg. Company, 1361 Goodyear Building, Kansas City Missouri.

FOOLPROOF paint-varnish remover, money back guarantee. Martinek 10 Company, 405 Lexington Avenue, New York.

DON'T read this unless you want a real live proposition. Combination Joke and Clutch Pencil, nickeled case, heavy metal, each with pocket clip. Big joke and for actual use. Sells at sight for $1.00. Send 50c for sample. Agent's cost in orders. Ten or more 35c each. 185% profit. Write for sample and agency. Ash Novelty Company, 1107 Xenia Avenue, Dayton, Ohio.

WATER STILLS, made entirely of heavy copper, one or four gallon capacity. Prices $30.00 and $50.00 respectively. Shipped prepaid by express or parcel post the same day we receive your order. Ideal for distilling water for automobile batteries, industrial uses and drinking purposes. References: U. S. National Bank, or Bradstreets, Omaha, Boyer & Co., PS 519 Farnham Building, Omaha, Nebraska.

ATTENTION: Salespeople—Agents—Sell B. & G. Rubber Aprons and Sanitary Specialties. They please your customers and the profits please you. Get our offer today. You'll be willing to accept it. B. & G. Rubber Company, 618 Penn Avenue, Pittsburgh, Pennsylvania. Dept. 17.

MR. ADVERTISER: Ask to-day for a copy of the "Quick-Action Advertising Rate Folder." It contains some really important facts which will prove interesting and valuable to you. It also tells "How You Can Use Popular Science Monthly Profitably." You'd like to know, wouldn't you? Manager Classified Advertising, Popular Science Monthly, 225 West 39th Street, New York.

HELP WANTED

DETECTIVES earn big money. Great demand. Travel. Experience unnecessary. We train you. Particulars free. Write American Detective System, 1968 Broadway, New York.

BE a detective. Excellent opportunity, good pay, travel. Write C. T. Ludwig, 424 Westover Bldg., Kansas City, Missouri.

STOP daily grind. Start silvering mirrors, Auto headlights, tableware, etc. Plans free. Clarence Sprinkle, Dept. 95, Marion, Indiana.

GET on the Stage. I tell you how! Send stamp for instructive Stage Book and particulars. A. La Delle, Box 557, Los Angeles, California.

BE a Mirror Expert, $3-$10 a day; spare time home at first; no capital; we train, start you making and silvering mirrors, French method. Free prospectus. W. F. Derr, Pres., 579 Decatur Street, Brooklyn, New York.

FIREMEN, Brakemen, Baggagemen, $140-$200, Colored Porters, by railroads everywhere. Experience unnecessary. 838 Railway Bureau, East St. Louis, Illinois.

OUR genuine gold window sign letters are an excellent money-making proposition for handy men. Slann Sign System, 7505 St. Antoine, Detroit, Michigan.

MEN—Age 17 to 45. Experience unnecessary. Travel, make secret investigations, reports. Salaries, expenses. American Foreign Detective Agency, 321, St. Louis.

MEN wanted. I want a few more men to train as draftsmen. Experience not necessary. Draftsmen earn $150 to $300 per month and more. Big demand. Splendid opportunities. Learn quickly at home. Let me send you Free Lesson. No charge. Address: Charles M. Morey, Director, 2239 Chicago Technical Building, Chicago, Illinois.

MEN wanted at $35 to $100 a week to make mechanical drawings. Work is easy, pleasant and leads to higher positions in Industrial Field at excellent salaries. We furnish set of instruments, train you at home, in spare time, by practical method and help you qualify for position. Write to-day for particulars, Roy C. Claflin, President. Dept. 1321, 14th and R Streets, Washington, D. C.

SILVERING mirrors, French plate taught. Easy to learn, immense profits. Plans free. Wear Mirror Works, Excelsior Springs, Missouri.

LEARN Drafting. Draftsmen make good money. Take up this interesting profession, but be sure you get your training in a real Engineering Institution and in a school which will give you a good well-paid position while you are learning the business. Write to-day for special offer to limited number of ambitious young men. School of Engineering, Dept. R-23, 373 Broadway, Milwaukee, Wisconsin.

WANTED—1500 Railway Traffic Inspectors; no experience; train for this profession thru sparetime home-study; easy terms; $110 to $200 monthly and expenses guaranteed, or money back. Outdoors; local or traveling; under big men who reward ability. Get Free Booklet CM-13. Standard Business Training Institute, Buffalo, New York.

PATENTS—Book free. Send sketch for free opinion of. patentable nature. Talbert & Talbert, 4846 Talbert Building, Washington, D. C.

BE an Expert Penman. Wonderful new device guides your hand, corrects your writing in few days. Complete outline Free. Write Mr. Ozment, 52, St. Louis, Missouri.

MEN wanted for Detective Work. Experience unnecessary. Write J. Ganor, Former Government Detective 115, St. Louis.

WRITE Photoplays; $50 each. Experience unnecessary; details free to beginners. Producers' League, 194, St. Louis.

BIG demand for graduate electrical experts. Prepare quickly under Electrical Engineer. Thorough Home Study Methods. Small expense. Albert Wood Wicks, E. E., Dept. 1777, 3601 Michigan Avenue, Chicago.

ARMATURE Winders make big money. We will train you for this interesting profession in three to six months, and will find you a good paying job while you are learning, so that you can earn your way. Write for special proposition. State age and education. School of Engineering, Dept. R-22, 373 Broadway, Milwaukee, Wisconsin.

MEN, get into the wonderful tailoring agency business big profits taking orders and your own clothes free. We furnish fine sample outfit and everything free. No experience needed. Write to-day. Banner Tailoring Co, Dept. 755, Chicago.

REPRESENTATIVE wanted, experience unnecessary. We sell any correspondence course or educational books published for one half regular price. We also buy used correspondence courses. Economy Educator Service, 1664 Broadway, New York.

$170 month average. Railway mail clerks. Hundreds wanted. List positions free. Write immediately. Franklin Institute, Dept. F43, Rochester, New York.

Quick-Action Advertisements continued on page 16

BE a detective—wonderful opportunities; particulars free. Wagner, 186 Est 79th, New York. Dept. 339.

GEODETIC and astronomical instrument maker by Coast and Geodetic Survey, Department of Commerce, Washington, D. C. Salary $1,400 per annum plus bonus of $240 per annum. For particulars write Civil Service Commission, Washington, D. C., for Announcement 605.

GET a good job—Work for Uncle Sam. Men and Women needed. $1400, $1600, $1800 at start. Railway Mail Clerk and other "exams" soon. Let our expert, former U. S. Government Examiner, prepare you. Write to-day for free booklet PS 29. Patterson Civil Service School, Rochester, New York.

WANTED at once, Show Cards and Sign Writers or those with artistic taste who can follow my ideas and make good income at home or traveling. G. W. Miller, 2050 Amsterdam Avenue, New York.

MR. ADVERTISER: Ask to-day for a copy of the "Quick-Action Advertising Rate Folder." It contains some really important facts which will prove interesting and valuable to you. It also tells "How You Can Use Popular Science Monthly Profitably." You'd like to know, wouldn't you? Manager Classified Advertising, Popular Science Monthly, 225 West 39th Street, New York.

BUSINESS OPPORTUNITIES

PATENTS—Book free. Send sketch for free opinion of patentable nature. Talbert & Talbert, 4847 Talbert Building, Washington, D. C.

ADDITIONAL Machine Shop and Foundry facilities available. Large manufacturing plant in Cleveland, well organized and equipped for machine shop, pattern shop and foundry production, will consider converting part of its production capacity to some manufacturer upon a low cost production basis. This is an ideal opportunity for manufacturer wishing Cleveland factory connection with a well organized plant. Address replies to the Nesbitt Service Company, Caxton Building, Cleveland, Ohio.

SUBSTANTIAL manufacturing corporation wants capable men to establish branch and manage salesmen. $300 to $2000 necessary. Will allow expenses to Baltimore as explained. Address Mr. Clemmer, 603 N. Eutaw St Baltimore, Maryland.

MAKE Big Money making marble, onyx, agate tile, etc., more beautiful and less than one-tenth cost of genuine. Marble and other fancy face brick, $15 thousand sell for $75. Cost of building reduced 25% to 50%. Experience unnecessary. Very little capital to start. Money-back guarantee if you fail with my instructions, based on 40 years' experience. Send for list of products and sample. B. F. Spencer, P. O. Box 213, Los Angeles, California.

PATENTS Procured—Trade Marks Registered—A comprehensive, experienced, prompt service for the protection and development of your ideas. Preliminary advice gladly furnished without charge. Booklet of information and form for disclosing idea free on request. Richard B. Owen, 44 Owen Building, Washington, D. C. or 2276-Z Woolworth Building, New York.

A GOOD paying business. Sell dollar article for fifty cents and make forty cents profit. I am doing it, why not you? Full details for quarter. J. P. Anskis, 1480 Louis Street, Camden, New Jersey.

EXPERT Chemist will furnish Formula and Trade Secrets in all lines. Lists free. W. L. Cummings, Ph.D., Gordon Avenue, Syracuse, New York.

BE a detective. Excellent opportunity, good pay, travel. Write C. T. Ludwig, 424 Westover Bldg., Kansas City, Missouri.

DOLLARS Yearly in your backyard. No mushroom dope. Particulars free. Metz, 313 East 89th, New York.

INSYDE tyres, inner armor for automobile tires double mileage and prevent punctures and blowouts. Quickly applied. Cost little. Demand tremendous. Profits unlimited. Details free. American Automobile Accessories Co., Dept. T-1802, Cincinnati, Ohio.

MAN or Woman, start anywhere; materials that cost equipment. Call or write for literature. Anderson Steam Vulcanizer Company, 2302 Grand Avenue, Kansas City, Missouri.

MR. BUSINESS MAN—would you like to be represented, and have the right to use a Newark Office address on your stationery and printed matter? I will represent any legitimate business for $2.50 a month or $20.00 a year. Send references with order to M. Ellis, 110 Riverside Avenue, Newark, New Jersey.

USED Correspondence Courses of all kinds sold. (Courses bought.) Lee Mountain, Pisgah, Alabama.

FOR sale—old established mail order manufacturing business. For particulars address Pioneer Aquarium, Racine, Wisconsin.

INVENTORS—My clients know every step taken in prosecuting their applications. Booklet sent free on request. Warner Cubberley, 20 National Union Bldg., Washington, D. C.

I MADE $30 a week evenings with a small mail-order business. Free Booklet tells how. 2c postage. Al Scott, Cohoes, New York.

SILVERING mirrors. Exclusive French tartaric process. Open enormously profitable business. Write P. Barstow, 514 23rd Street, Oakland, California.

BIG money in your spare time manufacturing letters for signs; no experience; free particulars. G. F. MacPherson, 675 Brown Avenue, Butler, Pennsylvania.

FORTUNES made every year raising silver foxes. Easy to raise. Will not interfere with your regular employment. Booklet free. C. T. Dryz, Box 1013, Eagle River, Wisconsin.

ENTER a new business. Earn $3,000 to $6,000 yearly in professional fees making and fitting a foot specialty; openings everywhere with all the trade you can attend to; easily learned by anyone at home in a few weeks, at small expense; no further capital required; no goods to buy, job hunting, soliciting or agency. Address Stephenson Laboratory, 15 Back Bay, Boston, Massachusetts.

MANUFACTURING Co-operation: A large, modern Middle Western Manufacturing Institution will consider proposals from inventors and small manufacturers for the purpose of buying outright or manufacturing on royalty. Prefer light brass products, but will consider any high grade proposition. Write at once Box 338, Kokomo, Indiana.

WE start you in business, furnishing everything. Men and women, $30.00 to $100.00 weekly operating our "New System Specialty Candy Factories" anywhere. Opportunity lifetime. Booklet free. H. Ragsdale Company, East Orange, New Jersey.

BUY and exploit practical inventions. Trade for property. Form companies. Sell county rights. Adam Fisher Mfg. Co., 183D, St. Louis, Missouri.

MEN, get into the wonderful tailoring agency business, big profits taking orders and your own clothes free. We furnish fine sample outfit and everything free. No experience needed. Write to-day. Banner Tailoring Co., Dept. 756, Chicago.

100 FINEST quality cards, beautifully printed, and leatherette case stamped in gold, 85 cents postpaid. Write plainly. Raymond Card Company, 410 Superior Building, Cleveland, Ohio.

START A Lucrative Business Of Your Own. We teach you how to establish and operate a successful collection business, and refer items to you. No capital necessary. Practically no competition. Walter Sanford, Nashville, reports $34,523.43 gross earnings last year. Jos. P. Cullen, Washington, sends sworn statement showing gross earnings of $8,039.07 for March. O. H. Overholser, Dayton, says: "I averaged over $360 net commissions monthly last year, and January shows $581.51 net. Such earnings bought my home and farm." Start now in spare time. You can succeed where 4,300 others have. Write to-day. Ask for "Pointers," and new plan. American Collection Service, 787 State Street, Detroit, Michigan.

START a profitable and interesting business at home making mission furniture. Special offer plans for making three leaders starts you, only $1, plans for making any piece of furniture in use 50c each; list for stamp. Albert Violett, 150 Smith Street, Providence, Rhode Island.

BIG opportunity for Sales-Manager capable of handling State Distribution. Marvelous new Calculating Machine. Retails $15. Work equals $350 machine. Five-year guarantee. Get details quick. Calculator Corporation, Grand Rapids, Michigan.

GOOD money easily earned at home, spare time silvering mirrors; no capital; free instructive book tells how. Paterson Company, Brooksville, Kentucky.

SEND for free book, "How to Succeed in Real Estate Business." State occupation. MacDonald Cooperative Realty Company, San Diego, California.

CHEMICAL analyses made. Formulas furnished by experts. No lists. A. Laboratories, 332 South Street, Jamaica, New York.

ROCK ISLAND Railroad Bonds (defaulted) A few $1,000 bonds cheap; only small number left; act promptly. Bonds, Box 1055, Millville, New Jersey.

DISTRIBUTORS and Dealers—Do you want to handle a real, live automobile accessory? Then write at once and secure the local sales rights for Pressed Steel Auto Lugs. They are almost a necessity where bad roads are found. A driver having a set of these lugs need never fear the worst kind of road. Simply attach to rear wheels and away you go. Can apply in less than a minute. Takes any automobile or truck out of mud, holes or ditches. Retails for $8.00 a set of four. Handsome commissions to dealers. An opportunity to make a lot of money. (It's some satisfaction to always have traction.) Sample set will be furnished if desired at retail price. Address World-Over Sales Company, 505 Fifth Avenue, New York City.

ARE you satisfied with the success you have made in the past? If not, give our line a chance and we are positive that you will be pleased with its money making possibilities. Our $5.00 to $20.00 annual premium accident and sickness policies may be sold to men and women—16 to 65 years—all occupations pay same rate. Million Dollar asset Company, established 1886. Liberal commission and territory. North American Company, 308 Walnut Street, Philadelphia, Pennsylvania.

WE buy practical meritorious inventions or patents or exploit for inventor on dividend basis. California Research Laboratories, 127 South Broadway, Los Angeles.

INVENTORS, list your inventions, patented or not patented or your practical ideas with me for sale. State price and terms; send specification. Thomas Morris, 1927 Manning Street, Philadelphia, Pennsylvania.

TWENTIETH Century Book of Recipes, Formulas, and Process contains 10,000 items covering a broad list of subjects. It is a money maker, too, for many of the formulas could be made the foundation for a small business at home. 800 pages, cloth bound. Price, $4, postpaid. Swanson Bros., 186 No. La Salle St., Chicago.

WE will start you in the cleaning and dyeing business, little capital needed, big profits. Write for booklet. The Ben-Vonde System, Dept. E, Charlotte, North Carolina.

START a cleaning, dyeing, and pressing shop in your own home. Large profits. Details free. A. A. Barnes, 5m, Helena, Arkansas.

STAMPS AND COINS

51 different stamps, also packet 5 unused, China ship set, 2 scarce animal stamps, large $1.00 U. S. revenue, perforation gauge, millimeter scale, ruler and price lists. All for 9c. We Buy Stamps. Fennell Stamp Co., Dept. C., Fullerton Bldg., St. Louis, Missouri.

CALIFORNIA gold, quarter size, ¼c; $½ size, 53c. White cent and catalogue 10c. Norman Shultz, King City, Missouri.

500 different stamps $1.40; 200, 28c; 100, 12c; approvals. Michaels, 5600 Prairie, Chicago.

158 Genuine Foreign Stamps—Mexico War Issues, Venezuela, Salvador and India Service, Guatemala, China, etc., only 10c. Finest Approval Sheets 50% to 60%. Agents wanted. Big 72-p. Lists Free. We buy stamps. Established 25 years. Hussman Stamp Company, Dept. 55, St. Louis, Missouri.

STAMPS, 20 All Different, 3 cents. Mention paper. Quaker Stamp Co., Toledo, Ohio.

$2 to $600 paid for hundreds of old coins dated before 1895. Send 10 cents at once for new illustrated coin value book. Size 4x7. It may mean your fortune. Clarke & Co., Coin Dealers, Box 76, LeRoy, New York.

17 varieties Bulgaria stamps, 20c. List of 7,000 varieties low priced stamps free. Chambers Stamp Co., 111C, Nassau Street, New York City.

STAMPS—50 varieties, Transvaal, Brazil, Peru, Cuba, Mexico, etc., and Album 10c. 50 different U. S., 25c, 1,000 hinges, 10c, 1,000 mixed, 40c. List free. I buy stamps. C. Stegman, 5949 Cote Brilliante, St. Louis, Missouri.

STAMPS—50 different British Guiana, China, Jamaica, Portugal, Venezuela, etc., 10c; 1,000 all different, fine collection in itself, $5.00; 100 var. U. S., 30c; 1,000 hinges, 10c. Agents wanted. 50%. List free. I buy stamps. L. B. Dover, Longmont, Colorado.

AUSTRIA, No. 144, Cat. 40c to all applicants for our approvals, and 2c postage. The Colorado Stamp Company, Undercliffe, Colorado.

OLD coins, large fall selling catalogue of coins for sale, free. Catalogue quoting prices paid for coins, ten cents. William Hesslein, 101-A Tremont Street, Boston, Massachusetts.

40 unused French Colonials, all different, 25c. Nickles, 122 Florida Avenue, Washington, D. C.

10c Packets—12 Argentine—5 Iceland—12 Norway. Bovard, Utica, Kansas.

25 different War Stamps, 25c. Buckey 712-A Bowen, Dayton, Ohio.

FRENCH Colonials, 50 different, for only 22c. Jacob Fischer, 1539 No. Lawler, Chicago.

BRITISH Colonies Stamp Packet Sent Free. Cornish, Schenectady, New York.

FREE packet. China, Canada, Brazil, etc., with request for 60% sheets. 50 var. cat. $2.50 for 50c. George Flagg, Mansfield, Massachusetts.

FREE—Rare stamp to collectors requesting my fine approvals. 50% commission. Enclose 2c postage. Ioor, 936 West 34th Street, Indianapolis.

He Has a Most Remarkable Knack for Reading Faces

How Tom Rutherford Makes $18,000 a Year!

I hadn't seen Tom Rutherford in nearly 10 years. When you consider that we had been pals at college, you can imagine how delighted I was to hear his cheery voice come ringing over the telephone.

He was on one of his big swings over the eastern territory and he wanted to know if I wouldn't come down and eat dinner with him at his hotel.

I found him to be the same old Tom—older of course—a trifle gray around the temples—perhaps a little keener of eye—but all in all the same old Tom. Success hadn't turned his head one bit and I felt no hesitancy in asking him how it was that he had been so successful.

"I can sum it up in five words," he said quickly—"The ability to read men. I can tell within three minutes after I meet a man the kind of man he is. I can tell if he is honest; I can tell if he is kind; if he is open to reason or if he is obstinate; if he is dependable; if he is careful or if he is careless. His eyes tell me one thing—his nose something else—his mouth, his lips, his forehead, his profile, his ears, every feature in fact has a never-failing message to the skilled observer.

L. Hamilton McCormick
Author of
"Characterology"

"Everybody reads character. Almost everybody can tell a clergyman from a ruffian or a bricklayer from a musician just by looking at their faces. But the important thing is to be able to read character when the lines are not so clearly defined.

"You know I had no more ability to start with than any one else. But one day I heard of a very rich man named L. Hamilton McCormick who had been making a life-time study of Character—as revealed in the face. I determined to visit him in his home and I did. I found him to be one of the most charming—most unusual men I have ever met.

"For forty years he had been making a study of CHARACTEROLOGY—not for money, for he is many times a millionaire, but through a desire to establish this study as an exact science. His study of types had taken him all over the world. After a lifetime of effort he had formulated certain definite rules for reading character. When he told me that any one who studied these rules could read character my enthusiasm knew no bounds. We got to be fast friends and I persuaded him to let me read the manuscript of this monumental work.

"From then on my success in business was assured. People marveled at my ability to swing conferences to my point of view—to make friends—to sell prospects who had been listed as impossible. It was all due to my ability to read men.

"For several years I have been urging Mr. McCormick to publish his rules for reading character. But always he would shake his head and say kindly—'Not yet, my dear sir. I must be ten times sure of every word before I offer this work to the public.'

"And now at last, CHARACTEROLOGY has been published. In it you will find every rule for reading character that has made my business and social life so successful. You, too, can become an expert reader of character if you study the rules laid down by Mr. McCormick.

"You will find this not only the most interesting work you have ever read but the most profitable. It is something that you can use every day of your life. I firmly believe—in fact I know—that my ability to read men is the one big reason why I am earning $18,000 a year."

* * * * * * * * *

Tom Rutherford said good-by that night but before he left I had sent to Rand McNally & Company for CHARACTEROLOGY. It has meant more to me than any other book I have ever read. As Mr. McCormick himself says—"There is no study of more importance to man than the study of man."

SEND NO MONEY

We want to send you this remarkable work on CHARACTEROLOGY. We are willing to send it to you on approval because we know that once you start reading it and begin applying its rules you will realize its practical value to you in every-day life. You need send no money. Without cost, without obligating yourself in any way, sign and mail the coupon printed below.

RAND McNALLY & COMPANY
538 S. Clark Street, Chicago

3 P.S.M.2-21

Rand McNally & Company, 538 S. Clark St., Chicago

Please send me Mr. L. H. McCormick's book on CHARACTEROLOGY. Within five days after receiving it I shall send you $5 or mail the book back to you.

NAME .....

ADDRESS .....

OCCUPATION .....

"You are foreman," said they together

THE SATURDAY EVENING POST, in its issue of October 9, tells the story. He was a retiring fellow—rarely ever asserted himself. Didn't have much to say. He blushed whenever a girl spoke to him.

But he did a lot of thinking and away back in his mind something whispered the old message "Knowledge is Power." So he began using his spare hours in studying the job above him. As he studied, he not only gained knowledge that enabled him to do his work better but his concentrative powers and his confidence increased.

One day the foreman didn't turn up. The superintendent and the general manager came into the shop discussing the foreman's sudden death. "Where will we find a man to take his place?"

And then like a flash, the modest young man realized the power he had been accumulating. With new-born confidence, he stepped before the bosses and explained that for two years he had been quietly preparing for a bigger job—that he could handle the foreman's work.

Said they together: "You are foreman!"

America everywhere needs men like this earnest young man—men of vision who see that what they put into their heads, through the study of practical subjects, is the best-paying investment, for it brings not only *more money* but *greater opportunity*, *larger responsibility*, and *bigger manhood*.

Many thousands of men in high positions today look back with satisfaction to a spare-hour course completed with the aid of earnest Y. M. C. A. instructors. Last year the Y. M. C. A. gave instruction to more than 107,000 men and boys who believed in such use of their spare hours. Today, with correspondence instruction added to their day and evening classes, the Y. M. C. A. Schools are teaching more men than ever before. The list below suggests a few of the 180 courses now offered—something for every ambitious man.

Extension Division

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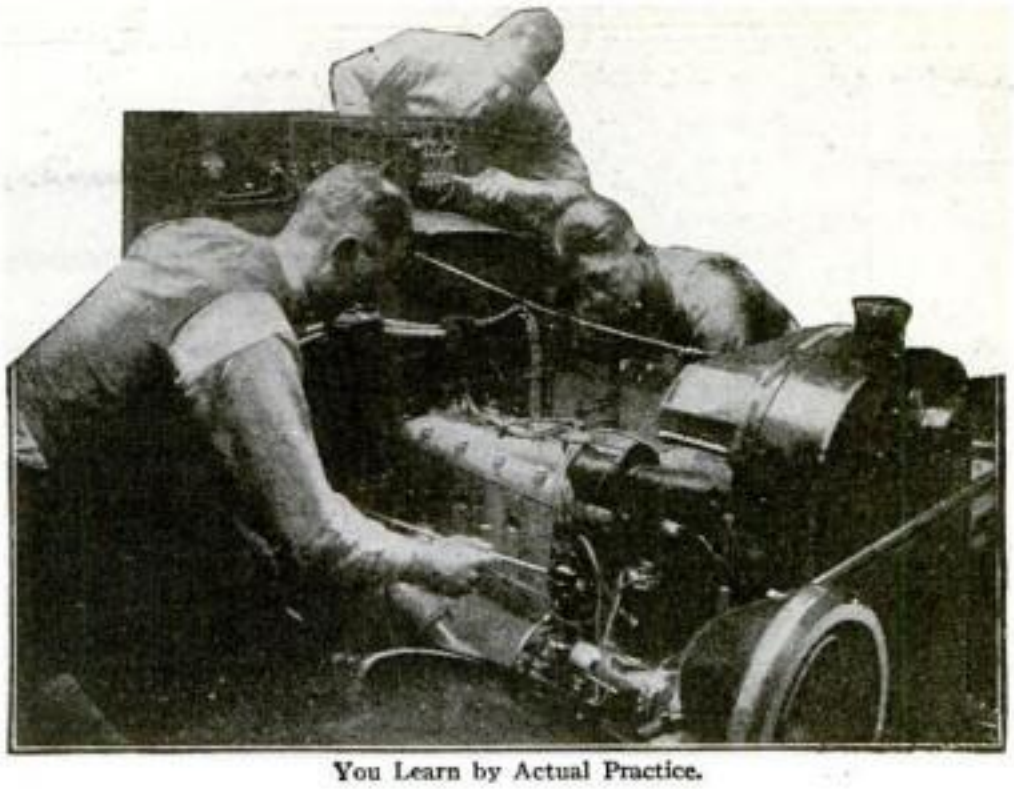

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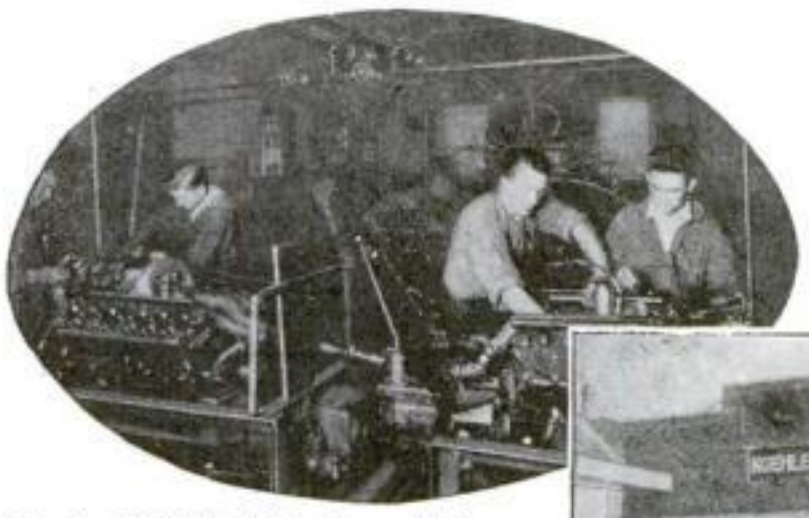

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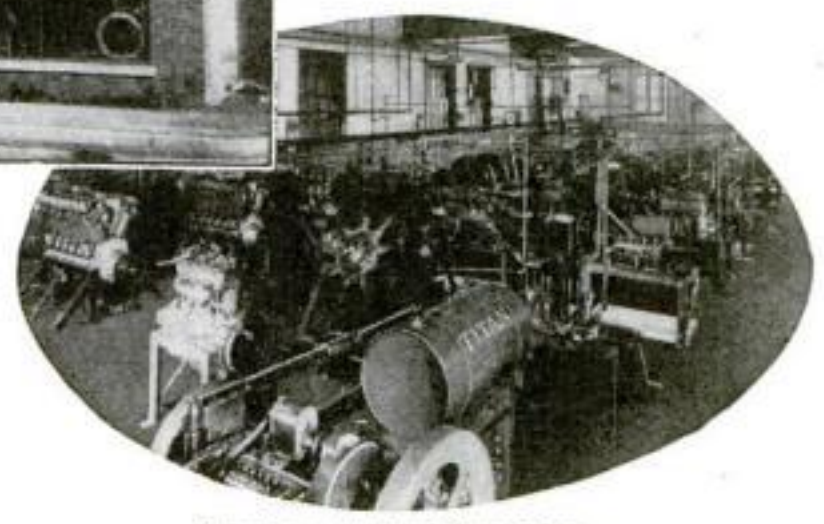

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Dear Sir:

This will acknowledge your letter of May 1, addressed to the attention of Mr. Vincent.

I would advise you to enter an auto school, as I believe you would get an all-around experience quicker than working either in a Factory or Garage. I understand that the Michigan State Auto School have turned out some very good men, and I do not believe you would make any mistake in attending this school if you wish to become thoroughly experienced in the automobile business. In this school you would get an opportunity to work on all different kinds of cars, and you would also have instructors who could explain the different parts, etc.

Yours very truly,
PACKARD MOTOR CAR COMPANY
J. D. Wilson
Ass't to Vice-President of Engineering

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How Did Columbus Discover America?

COLUMBUS was not a happy-go-lucky adventurer. He was fired by the spirit of discovery, the spirit of research.

A man who engages in research never knows what he will discover. So it was with Columbus. He discovered among other things the variation of the compass needle. He opened up an entirely new continent. He was the first to acquaint Europe with the strange new people, animals and riches of the western world. He conducted research on a large scale.

There is a greater similarity between Columbus' voyage of discovery and laboratory research than may be supposed. The man in the laboratory who tries to discover the "why" of things is a Columbus. He substitutes facts, knowledge, for guesses and plausible theories. And, like Columbus, who observed strange deflections of the compass needle, he discovers phenomena undreamed of before.

Every investigation conducted in the Research Laboratories of the General Electric Company at Schenectady, New York, is a voyage of discovery. Where will it end? What will be disclosed? No man can tell. But year in and year out the very constitution of matter is studied, and new principles are revealed that make the world a better place to live in.

The modern vacuum and gas-filled tungsten lamps, which give three and four times as much light for the same money as the old carbon filament lamps, were developed when the scientists in the Research Laboratories tried to find out why tungsten could not be handled like other metals and what were the conditions under which hot filaments glowed in the best vacuum that could be produced in a glass bulb. The world was enriched by new facts, new knowledge. And the commercial product was the cheapest light thus far produced.

It is not a purely business purpose that dominates the Research Laboratories, but the spirit of inquiry, the desire to increase human knowledge. Yet commercially valuable results always follow when research is thus conducted.

Through MAZDA Service the lamp industry learns of the work done in the Research Laboratories when it has a commercial application. And through MAZDA Service the Research Laboratories at Schenectady learn of discoveries of possible value made in other institutions and of the technical difficulties encountered by lamp manufacturers. So, MAZDA Service is both collector and distributor of information. It has its nerves in laboratories where lighting is studied and in factories where lamps are made. When a new discovery is made either in the Research Laboratories at Schenectady or elsewhere, the industry is sure to benefit by it through MAZDA Service.

There is only one MAZDA Service, but there is more than one manufacturer of MAZDA lamps. Hence a lamp is marked MAZDA because its manufacturer is entitled to receive the benefit of MAZDA Service, which is centered in the Research Laboratories at Schenectady.

MAZDA, then, is a Research Service Mark. It stands for progress made by scientific research in the Laboratories at Schenectady.

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RESEARCH LABORATORIES OF GENERAL ELECTRIC COMPANY

Popular Science Monthly

Waldemar Kaempffert, *Editor*

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Measuring the Emotions

A way to test a man's fitness for his task

By P. J. Risdon

English correspondent of the Popular Science Monthly

THE resistance that the human system offers to the passage of an electric current varies according to the emotional condition of a subject. As mental disturbance increases, this resistance is reduced and permits of the passage of an increased current.

Dr. A. D. Waller, the director of the physiological laboratory of the University of London, applied the principle in an invention that actually measures the emotions and that should be of considerable value to medical men in diagnosing mental and nervous diseases.

The apparatus comprises a system of electric wiring connected with a galvanometer (an instrument that measures the effect of variations in an electric current by which it is influenced). The variations are recorded by means of a delicately balanced needle or pointer; a tiny reflector moves in sympathy with the needle.

A light is concentrated on the reflector. As the reflector moves, a beam or bead of light reflected from it travels along a graduated scale. For convenience the scale may be placed in front of a mirror, so that the operator and subject may both see the movement.

In the electric circuit is a pair of Lechanche cells and another small battery. A pair of aluminum disks (called electrodes), wired up to the circuit, is attached to the hand of the subject, one being placed against the palm and the other on the back of the hand and held in position by rubber bands. Blotting-paper soaked in salt water is inserted between the disks and the hand to insure an unbroken circuit. A number of switches enable the operator to vary the resistances in

Aluminum electrodes are attached to the hand of the subject—one against the palm, the other on the back of the hand. These are electrically connected with a reflecting galvanometer.

Variations in the electric current are recorded by means of a delicately balanced needle with which a tiny mirror moves in sympathy. The light is concentrated on the mirror. As it moves, the beam reflected travels along a graduated scale.

Lunge at the subject with a pin with the evident intention of pricking him, and the light moves rapidly to the very end of the scale.

the circuit and the amount of current flowing.

Now, the emotional response of different persons varies greatly, and indeed the response of any one person varies considerably according to the time of day or night and to his or her health.

Consequently the apparatus has to be calibrated or set so that at the commencement of operations the bead of light is at zero on the scale while the subject is perfectly quiet and free from excitement and disturbing influences.

I cannot do better than relate here the tests to which Dr. Waller subjected me.

Upon entering the laboratory, I noticed that the electrician's hands were badly scarred, and questioned him as to whether it was Dr. Waller's doing. He made a motion of his head in the affirmative.

I was seated in a comfortable armchair.

"Compose yourself and smoke," said the doctor.

Meanwhile the electrodes were fastened on my left hand and the instrument was calibrated until the spot of light was stationary at zero.

Anticipation Is Worse than Reality

Without the slightest warning, Dr. Waller then picked up a pin about four inches long and made a lunge at my right hand without touching it. The bead of light moved right to the end of the scale and very slowly returned.

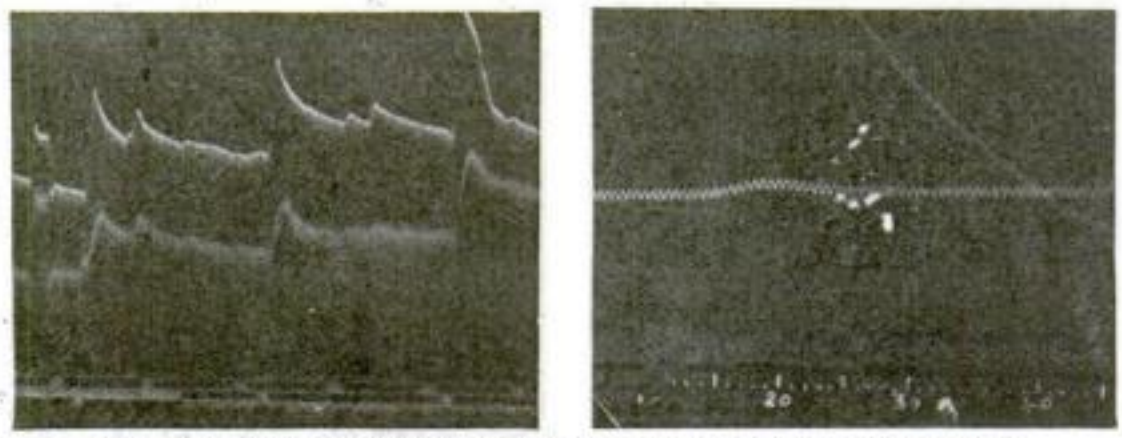
Have you ever heard a Klaxon horn sounded in a laboratory? That was what next happened, with the same result.

Then Dr. Waller really did prick my hand with the pin; but the effect was less pronounced than when he pretended to do so.

Such is the sense of duty to one's editor, and so ready to suffer must a correspondent be, that I positively asked to be burned so as to record the effect. Twice Dr. Waller fumbled about with matches and sent up the bead of light. When he finally struck a match and actually applied it, the effect was much less pronounced than that produced by anticipation of a burn. In fact, the bead moved so little that some one suggested a red-hot poker, whereupon the bead completely disappeared as I thought of the electrician's hands.

I was then told to recompose myself. As the bead returned, a pungent odor, not infrequently encountered in laboratories, had the effect of sending it up the scale again.

Dr. Waller next warned me that he was going behind to do something to me of which I had no conception. Knowing what had already been done and what hadn't, and thinking of red-hot pokers and of the electrician's scarred hands, the spot of light traveled up that scale in a way that made me blush for shame when I felt my ear tickled after half a minute's suspense.



How the emotions write their own autograph, according to Dr. Waller's method. These records were made in order to show the similarity of movement when hand and foot electrodes are used

The last of the experiments practised upon me consisted in first composing myself until the bead was steady at zero. I was told to think of something (other than red-hot pokers) which had been a cause of worry and anxiety. That was easy enough—the only difficulty was to keep back a crowd of thoughts. I began to wonder what the editor would think of my adventure, and the bead of light traveled out of sight and remained there until Dr. Waller broke the spell.

So, an unpleasant taste, a feeling of nausea—indeed, almost anything that temporarily disturbs equanimity—is recorded.

As a result of a great number of experiments, Dr Waller concludes that, as a general rule, subject to some exceptions, anticipation produces a more powerful effect upon naval and military officers and members of the literary, artistic, and scientific professions, and that it is principally manual workers who respond to actual experiences more than to anticipation, which accords with most preconceived ideas upon the subject.

An important point about the instrument is its calibration. When it is set to suit a certain person's temperament, the diagram of results obtained cannot be directly compared with those obtained from another person for whom the instrument is differently calibrated. In other words, although zero on the scale (where the bead of light is at rest) is always in the same position, that position does not represent the same degree of equanimity for each person who is tested.

A Curious Fact

A curious fact in connection with the experiments is that they can be satisfactorily made only with electrodes or metal disks on the palms of the hands or the soles of the feet. Thus the electrodes may be on either side of one palm, or one may be on the palm of one hand and the other on the palm of the other hand. The current from the Lechanche cells serves to equilibrate or balance the galvanometer reflector. The small electric cell sends a current of about one tenth of a volt through the circuit and the disturbance of the galvanometer by this additional current (which varies according to the resistance of the subject) causes the galvanometer reflector to move and the bead of reflected light to travel up and down the scale.

One of the strangest features is that the extent of the subject's emotions is recorded whether he be conscious of any emotion and whether he show any external sign of it or not. Indeed, pent-up emotion effectively concealed and controlled is indicated in a more pronounced manner than if relieved by weeping; and this applies equally to other controlled emotions. Presumably swearing will now be considered justifiable.

One may hope that Dr. Waller will succeed in developing his invention so that different emotions, such as anger, sorrow, and fright, may be distinctly recorded.

Here Professor Waller is measuring the energy which is expended in riding a bicycle

Cameras and Divers to Restore French Coal-Mines

BEFORE they retreated from the Lens district in France, the Germans flooded the coal-mines. Because France was thus deprived of one of her most important coal-beds, it was provided in the Peace Treaty that an adequate amount of coal must be turned over by the Germans to France. In the meantime, every effort is being bent to restore the mines to their former condition. To pump out the water will be a labor of months. Moreover, to facilitate it, the engineers must know exactly where the shafts and galleries were punctured.

Accordingly, the French government decided to use an under-water camera for taking photographs of the shaft lining. The apparatus was supplied by the submarine engineers, Siebe, Gorman and Company.

Photographing under water involves the use of powerful lights. But even the most powerful lights in the turbid water of a deep shaft reveals little; its beams have but little penetrating power even under the most favorable conditions.

Artificial Sunlight for Under-Water Photography

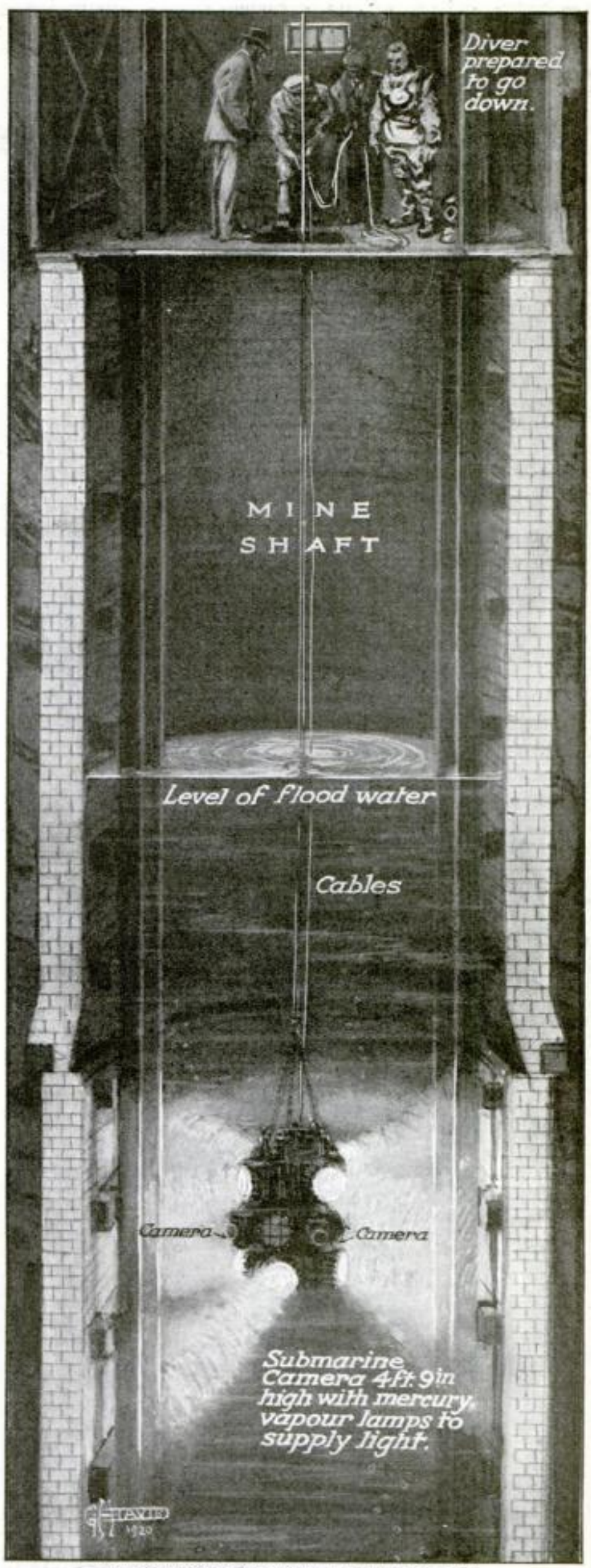
White sunlight is a composition of many colored rays; but those that are of greatest value in photography we cannot see at all. They are located at what is known as the ultra-violet end of the spectrum; they are the chemical rays that cause sunburn. These powerful ultra-violet rays will not pass through ordinary glass, but they will penetrate a glass made of pure quartz. Hence, the light by means of which photographs are made in the shafts of Lens radiate a light that is rich in ultra-violet rays. Instead of glass, quartz is used, which encloses a mercury-vapor arc. The light of the mercury-vapor arc is familiar to many who work in factories and photographic galleries; it was invented and introduced by Peter Cooper Hewitt. Its color is a ghastly green, due to its lack of red.

This lamp, then, supplied with quartz instead of glass, is used in the camera to photograph the inundated walls of the Lens mines.

The camera itself consists of three main gun-metal castings bolted together one above another. The upper and lower castings are each formed with four water-tight chambers, and each of these chambers contains a mercury-vapor lamp of three thousand candlepower. The cameras are in four chambers in the middle casting, which also carries four additional lamps, making a light-totality of thirty-six thousand candlepower. The shutters of the cameras are electrically controlled. Special levers, actuated by rods, are provided to tilt the cameras.

Repairs can be made by a diver after photographs have been made. After the holes have been stopped up, it is an easy matter to pump out the water.

Here is the apparatus that is lowered into the flooded mines of Lens, France, to make photographs of their present condition

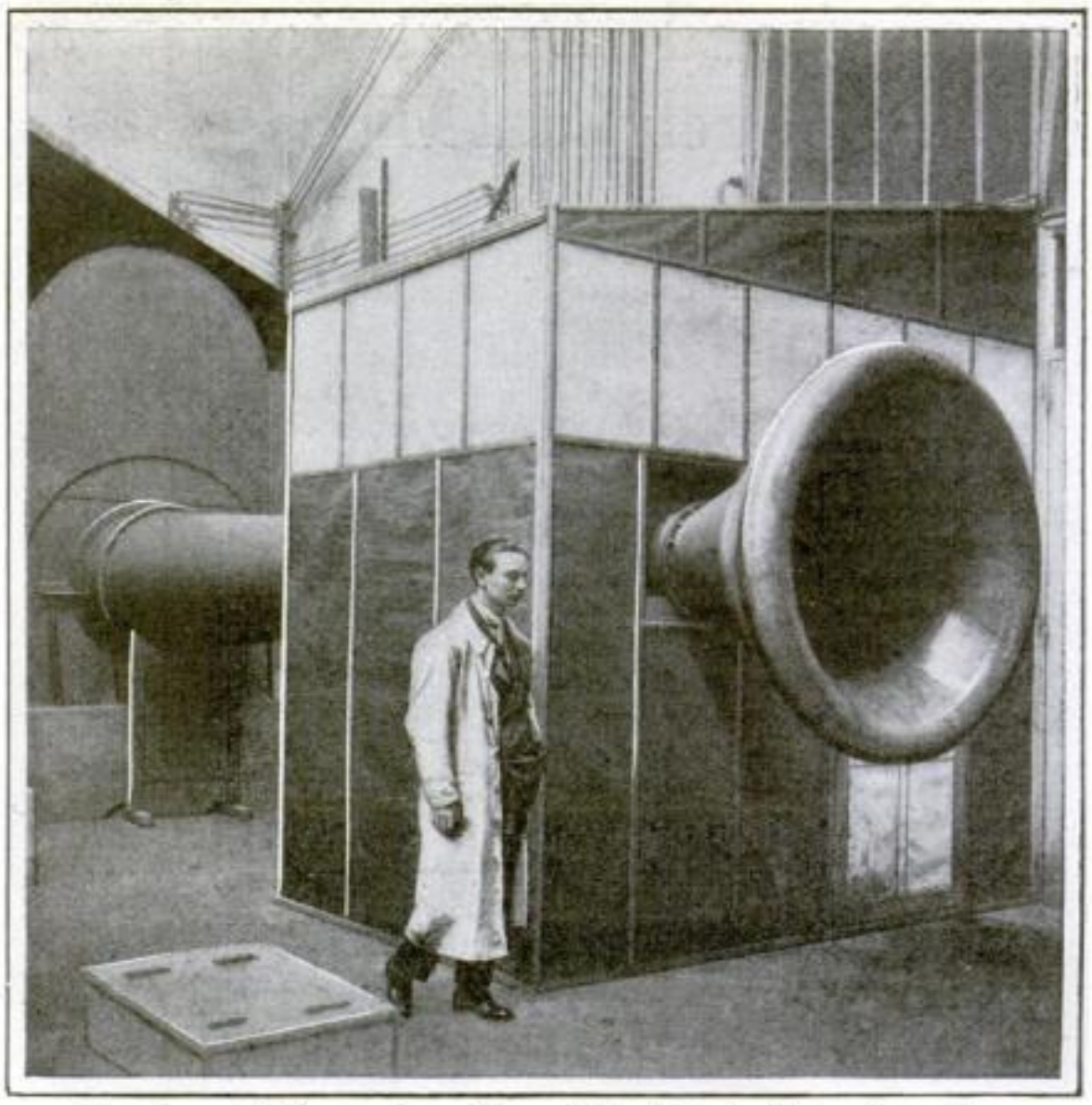


How the under-water camera and its lamps are lowered into position to photograph the shaft linings of the Lens coal-mines so as to locate breaches made by the Germans in order to flood the mines

Perfect Airplanes Are the Result of Wind-Tunnel Tests

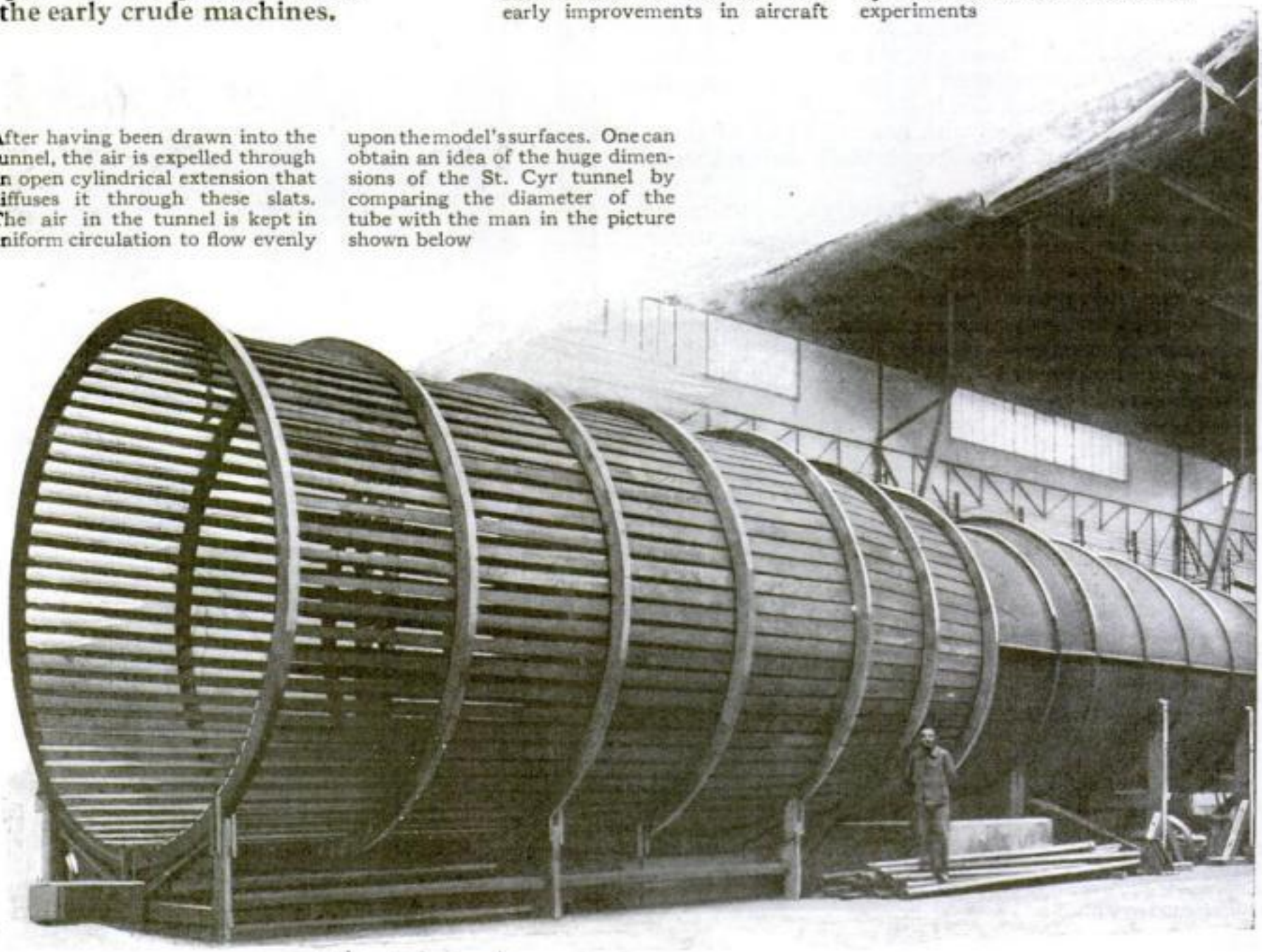
THE airplane model is placed in a chamber in a long tube through which air is drawn in parallel currents. Instead of moving the models in the air, the air itself is in motion, which amounts to the same thing, as it is the relative motion that sustains a body heavier than air in flight.

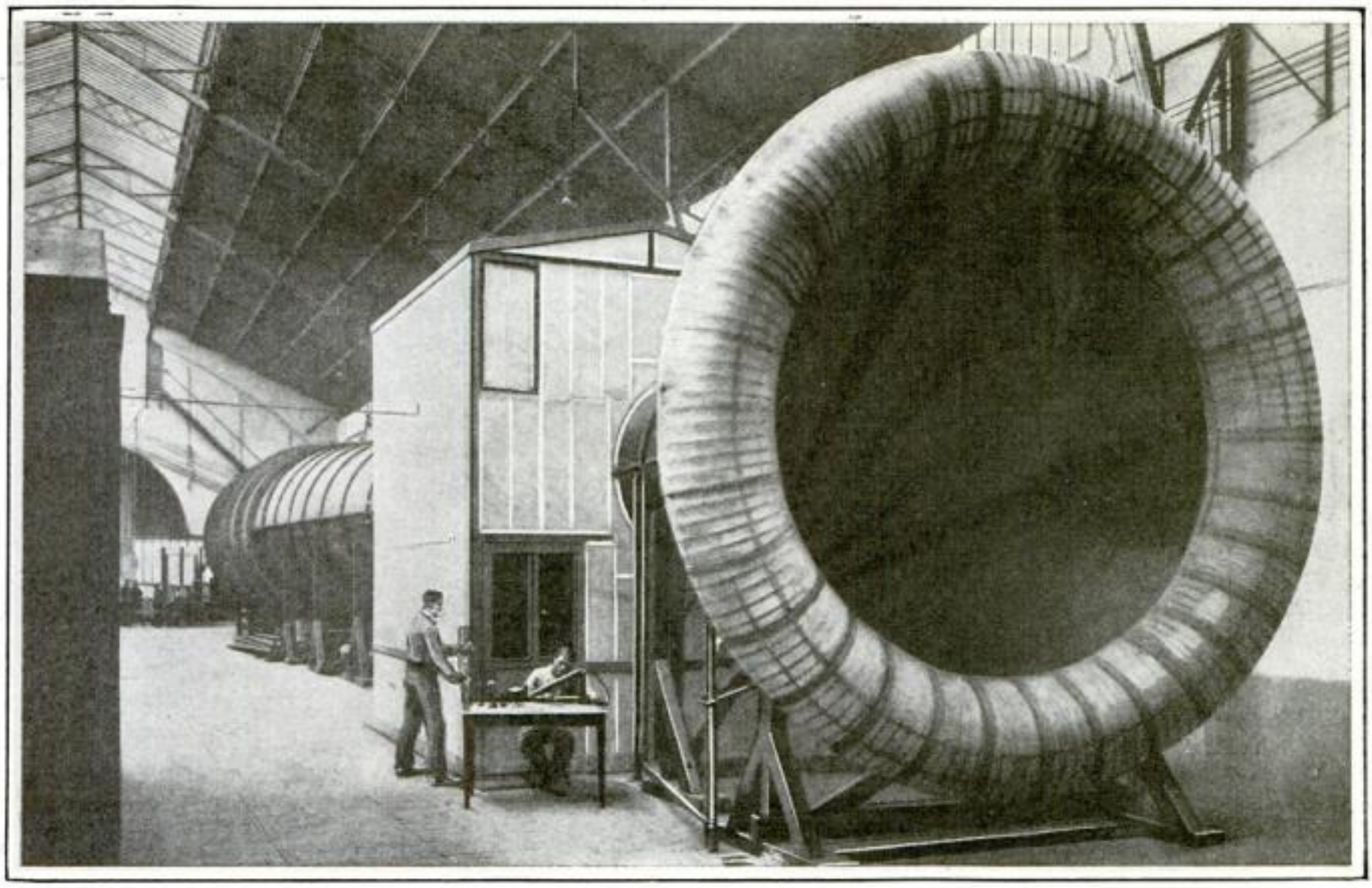
Attached to the model is a delicate scale called an "aerodynamic balance"; it measures the wind forces to which the model is subjected. Then one model is compared with another until one is obtained that offers the least resistance to the wind. Lessen the wind-resistance of any moving body, and you cut down the amount of fuel required to drive it at a given speed. Only by such experimenting was the airplane developed to its present form from the early crude machines.



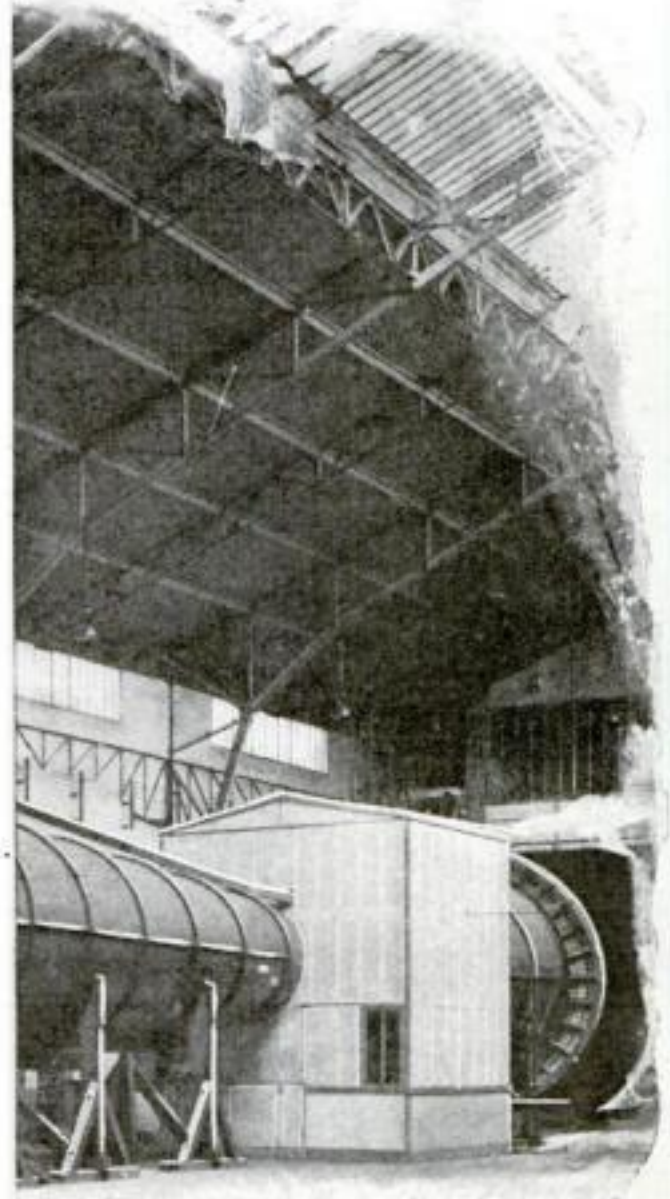
Here is one of the smaller wind-tunnels at St. Cyr, France. It shows the chamber in which both the model and the aerodynamic balance are placed. It was with such smaller tunnels that the early improvements in aircraft design started. Nieuport was the first to attain greater speed merely by giving an airplane a form that offered the least resistance to the air and he was guided chiefly by the results of wind-tunnel experiments

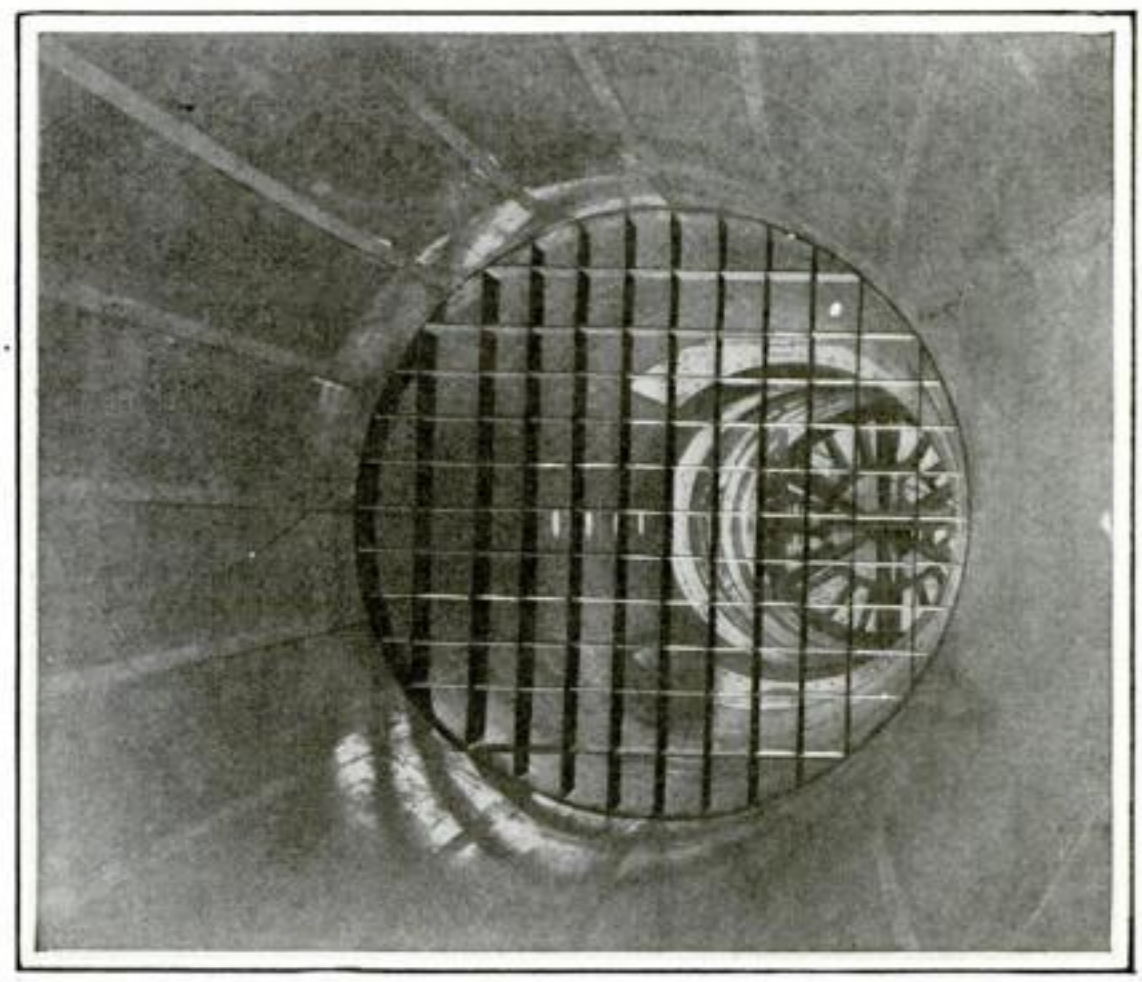
After having been drawn into the tunnel, the air is expelled through an open cylindrical extension that diffuses it through these slats. The air in the tunnel is kept in uniform circulation to flow evenly upon the model's surfaces. One can obtain an idea of the huge dimensions of the St. Cyr tunnel by comparing the diameter of the tube with the man in the picture shown below



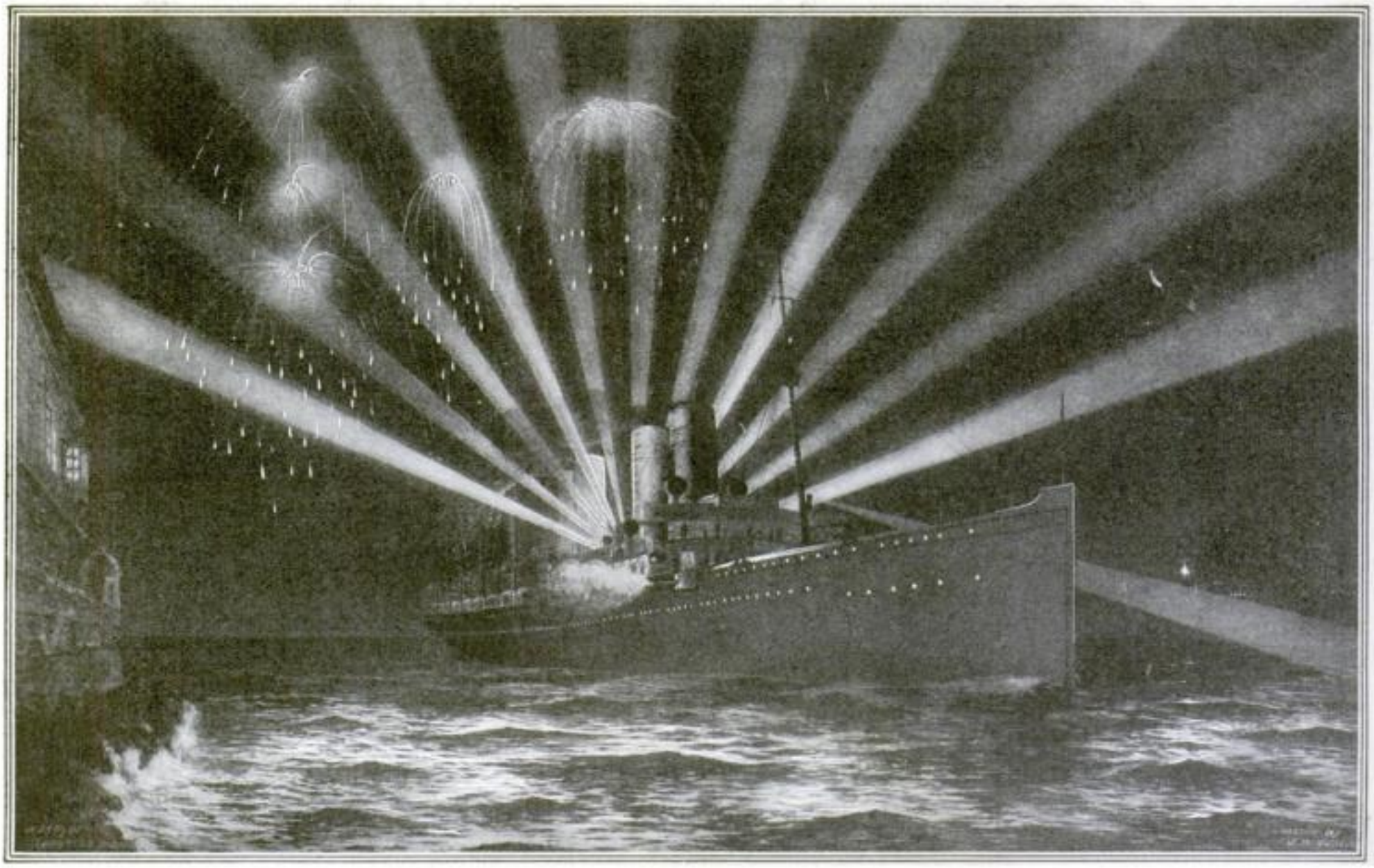


Outside the experimental chamber in which the aerodynamic balance and the model are placed sits a man at a table. His duty is to read the velocity of the air that is being drawn through the tunnel. When a hundred-mile-an-hour gale is sucked through the tunnel, it is practically impossible to open the door of the instrument-house in the center—so terrific is the suction





The air is composed of countless eddies and swirls. A straight stream is wanted. Hence a grid like that shown is used to break up the eddies—a kind of sieve, in other words. The speed of the wind can be varied from a zephyr to a hurricane. The model is suspended in the chamber above the aerodynamic balance and the air is drawn through the tube. Weights are added to the balance until the model becomes stable and steady. These weights measure the compensation of the forces of the air



Mid-Ocean to Become a Great White Way?

SOME of our transcontinental express trains carry powerful searchlights to entertain the passengers on the observation-car platform. The powerful beam plays over the interesting parts of the passing scenery. Great fan-shaped beams of light flickering over the Panama-Pacific Exposition grounds amused the crowds.

Now it is proposed that the floating palaces of the sea adopt the idea. It would indeed be an amazing spectacle to see a great ship blazon herself on a still night of the sea, rockets breaking and shedding their scarlet rain on the dark waters.

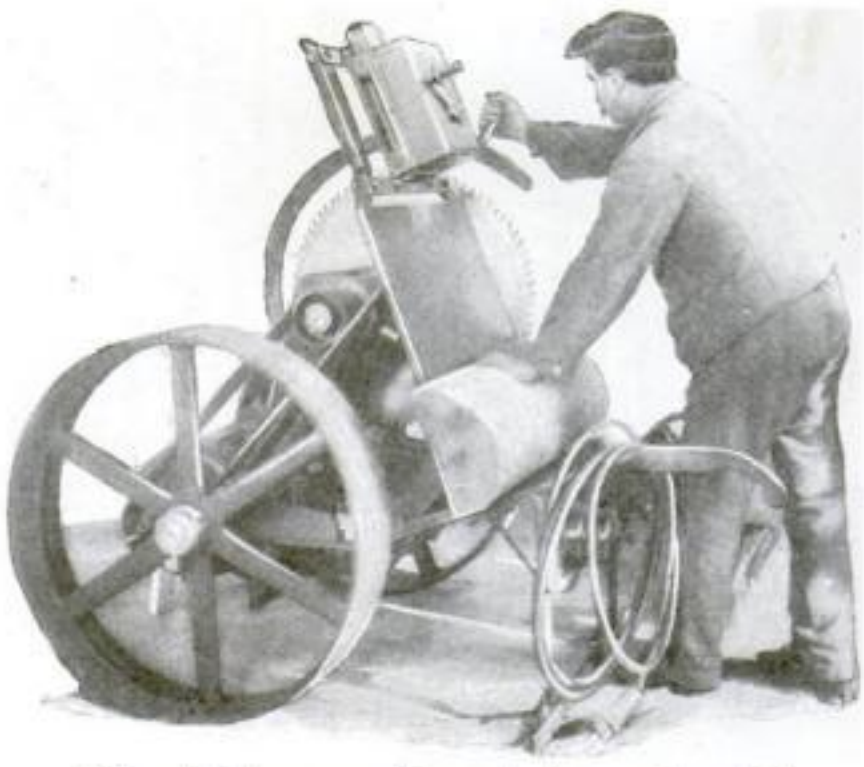
Searchlights have reached a high point of efficiency, and the current to supply twelve large lights would be taken from the power plant of the ship without overtaxing it.

An Electric Sawmill on Wheels

WHEREVER electric power is available, be it in a shop or on a farm, the transportable electrically driven circular saw shown here will prove very valuable. A small electric motor, which may be attached to any plug, furnishes power for the circular saw, which is large enough to cut four-inch planks.

The miniature sawmill rests on two large wheels and two supporting braces, and may be rolled to any spot where it is needed, even over rough pavement or sandy soil. It has been used successfully and economically in Germany, in spite of the fact that the cost of electric power in that country is considerably higher than in the United States.

In view of the fact that electric power is rapidly supplanting steam power or the power obtained from gasoline engines in this country, and that in most localities farms can be supplied at comparatively small cost with electricity, this sawmill should be of interest to the American farmer.



This miniature sawmill on wheels can be rolled to any spot where needed; it is run by electricity

Stronger Propellers for the Airplane

A PILOT landing a DN4 airplane at high speed encountered muddy ground. The wheels sank into the mud and the machine nosed over, the propeller making a number of turns in the mud.

If this vital part of the airplane had been made of wood, it would have splintered into match-sticks. But it was made of "micarta," laminations of cloth or paper coated in "bakelite" and subjected to heat and pressure. What is bakelite?

Bakelite is a composition derived from the combustion of carbolic acid, creosol or phenol, and formaldehyde. Combined, these form a resin that, when subjected to combined heat and pressure for a suitable time, carries the material into a hard state not affected by ordinary solvents or temperatures that would disintegrate a gum or resin.

Making Masks Is the Hobby of Wladyslaw Benda

By P. Schwarzbach

Mr. Benda wearing one of his hideous masks and carrying the lifelike heads of two girls. He makes these masks in his leisure moments and hangs them on his studio walls

Working with wrapping-paper and cardboard, Mr. Benda gradually builds up wonderfully lifelike masks. He gives them several coats of paint until they are as smooth as skin

This fearful creature has really a sweet and gentle heart within. For beneath its silken robe is the body of Mr. Benda. In spite of the large size of the mask, it is very light

PICK up almost any fiction magazine today and you will see the name "Benda" in the corner of many of the illustrations. Mr. Wladyslaw T. Benda comes from Poland and he gives to the men and women of his pictures the high cheekbones, the slanting eyes, and the delicate chins peculiar to the people of Slavic origin. Yet he also puts plenty of American features in them.

When you enter Mr. Benda's gorgeous studio in the Gramercy Park section of New York, you are reminded of the "Arabian Nights." The walls are decorated with draperies and pictures of glorious barbaric color. And here and there you see a head so lifelike that, if Mr. Benda were not such a quiet, unassuming man, you would feel sure that he was a follower of Bluebeard. When you ask him about these almost human masks, he modestly tells you that he has made them himself!

What materials does he use? Wrapping-paper, cardboard, paste, and paint. He starts with strips of wrapping-paper and molds them bit by bit; he reenforces the weak spots with cardboard. Thus with neither forms nor casts to aid him, he gradually builds up a face. When it is finished, he gives it several coats of paint until it is as smooth as skin and has the true skin color. He paints in the eyebrows and lips, and cuts out nostrils, eyes, and airholes in the forehead. As a matter of fact, he does not actually cut holes for the eyes, but rather punches them in. The rough edges thus made are painted black and serve remarkably well as eyelashes. The inside of the mask is just a mass of short ends and glue; but when the mask is finished, this gets a coat of paint as well.

We are all familiar with masks. On Thanksgiving Day nearly every small boy in the country dresses up in his mother's or sister's clothing and buys a mask that completely transforms him into another person. In drama and in dancing, masks such as those that Mr. Benda makes are a great help to the actors when they wish to portray various characters.

Even in the days of ancient Greece and Rome, actors wore masks. In England, just after Shakespeare's time, a form of drama known as the "masque" became very popular. And now we find it coming into existence in this country. Several of Mr. Benda's masks have been worn by Margaret Severn, a well-known New York dancer.

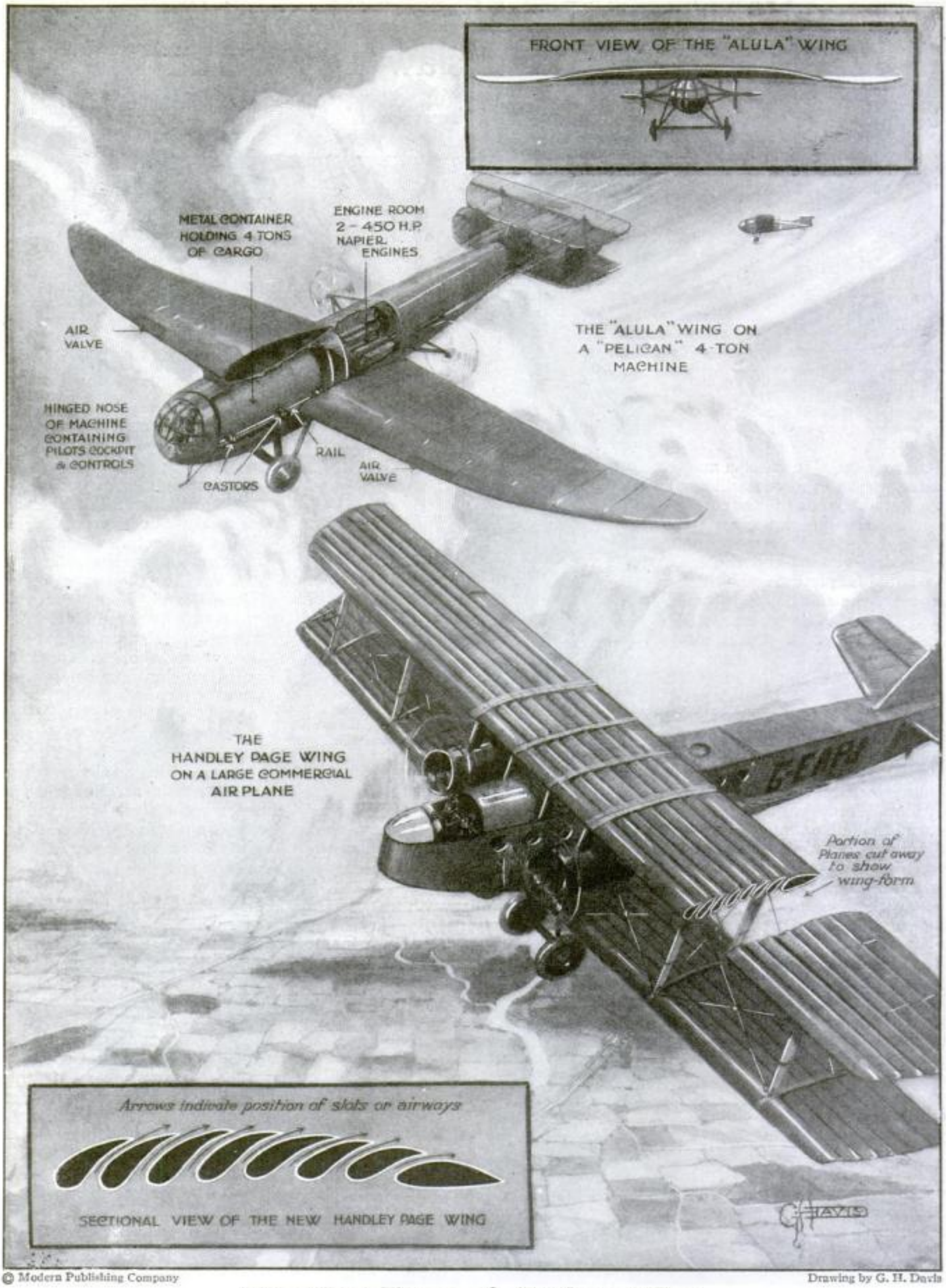
Some of his masks represent shy, demure maidens. He is shown below wearing one of this type, and, as you see, it completely transforms him.

He put on the mask of a terrible deep-sea god, and looked so fierce that the spectators instinctively glanced toward the door. Mr. Benda has made several other strange masks, vividly painted in striking colors. Some of his women's faces are haughty as well as shy. Some wear simple caps and others huge golden headdresses. One in particular has two long (wrapping-paper) feathers of gold that curl gracefully and sway slightly when the mask is moved. There is also a perfect head of a Japanese girl and the head of an angry man.

Mr. Benda spends much of his leisure at this strange form of sculpture; and he has two able assistants.

One is a large black cat with the largest tail in the world, and the other is the smallest black kitten that ever climbed up the back of an upholstered chair.

"What a sweet girl!" you exclaim, looking at the picture to the left; then suddenly you notice the trousers and big feet that show below the edge of the kimono. They belong to Mr. Benda. He is shown working on a mask in the picture to the right



Drawing by G. H. Davis

Two New Types of Airplane Wing

In the new Handley-Page wing (shown in the lower part of the picture) is a series of hollow curved vanes that convert a single large wing into a number of small ones. By thus exposing a larger area to the air, the lifting power is enormously increased.

In the Alula wing (shown at the top of the page) an important consideration is the eliminating of the "end losses" due to the curvature of the ordinary wing-tip. This is overcome by apparatus contained in the Alula wing and operated by the navigator

Wings that Lift Heavier Loads

English designers are making renewed and effective efforts to rival the birds in the air

By P. J. Risdon

English correspondent of the Popular Science Monthly

ONE of the many difficulties encountered by aviators is to land in a reasonably short distance at a reasonable speed, especially in the case of forced landings. Another is to rise in a short distance. It is obvious that in the case of large machines carrying heavy loads this difficulty is enhanced, for the simple reason that the heavier the machine the greater the power and speed requisite to maintain it in the air. By means of the Handley-Page new wing, the distance run in getting off and in landing is reduced by twenty-five per cent.

This new wing of Handley-Page must be regarded as one of the most remarkable and important improvements in airplane design that has been made in years. In an elementary form it has already been tried on a de Haviland plane (D.H. 9) with a 230-horsepower Siddeley engine with remarkable results.

Greater Wing-Lift Attained

What is most noteworthy is the enormously increased lift of the new wing. Even the experimental airplane developed fifty-five per cent greater lift than another of exactly the same type without the special wing attachment, which was tested at the same time under precisely similar conditions. This result was secured by a single additional vane fitted in front of the ordinary leading edge of each wing. With wings constructed entirely to the new design, it is estimated that the lifting power will be increased to such an extent that for a given horsepower of engine the same weight will be lifted by a wing area of not much more than half the usual area. Alternatively the same wing area will lift nearly twice the load for the expenditure of the same horsepower, or the same load with a great reduction of horsepower.

The design of the wing itself consists of a series of hollow curved vanes or narrow wings which overlap but do not touch each other. At first sight it would appear that by thus allowing air to flow through the vanes the lifting power would be reduced, but that is not so. The spaces between the vanes virtually convert a single large wing into a number of small ones, so that there is a far greater total area exposed to the air than in a single wing, thus increasing the lifting power.

In future machines there will be five movable vanes arranged so as to open and close on each other somewhat in the manner of Venetian blinds or hinged louvers. The movement will, of course, be under the control of the navigator, who will control the extent of lift according to whether he is "getting off," flying, or landing. For instance, when he desires to attain full speed, he will close the vanes and practically convert them into a single wing. When he desires to reduce speed and to land, he will open them.

Owing to their small size as compared, load for load lifted, with ordinary wings, the new wings can be built much more stoutly, thus bringing the day of really efficient all-metal wings within sight.

In the experimental machine, the additional small wings were fitted in front of the ordinary wings. The vanes extended from tip to tip of the wings, and were attached a few inches in front of the leading edge of each main plane by short bars. Even with this comparatively crude attachment, the navigator was able to fly at a speed of fifteen miles an hour less than the minimum speed without it; and although the tail was well down and the nose up and "stalling" appeared imminent, actually no such thing occurred.

Apart from this practical demonstration, extensive laboratory experiments and tests have proved beyond question that the principle involved is a sound one on which to proceed.

The Alula Wing

The Blackburn Company of England have evolved an entirely different type of wing, which dispenses with movable flaps, known as "ailerons," by means of which "banking" is effected. Here again greater lift for a given power was the main object, although there are other special features about both the wing and the airplane to which it is being applied.

In ordinary planes there is a considerable loss of power and lift, due to the curvature of the wing-tips. In the Alula wing these "end losses," as they are termed, are eliminated. As the picture on the opposite page indicates, in plan the wing has a curved leading edge and a straight trailing edge. Viewed edgewise, the trailing edge is horizontally straight, while the leading edge is straight in the center portion, then it curves downward, and finally curves slightly upward. Between the leading and trailing edges the plane winds or curves in a manner determined by experiment.

In the curved portions of the leading edge are a pair of hinged flaps under the control of the navigator. The effect of opening one of these flaps, or valves, is to "spill" the air, in much the same way that a jet of water directed into a jar is flung out again.

What the Flaps Accomplish

The opening of one flap increases the resistance of the wing to which it is fitted, and the disturbed air whirling past the plane reduces its lift, allowing it to sink, and causing a corresponding lift of the other wing, so that the airplane automatically banks. Thus turning and banking can both be accomplished without the use of ailerons or rudder, although it is not proposed to dispense with rudders.

It was found necessary to raise the wings to a higher level, so that the planes are directly above the body of the machine. It is considered that the wing gives the best results on a monoplane, and it will be applied more particularly to air "tramps." Owing to the increased lift obtained, slower speeds are possible with heavy loads, and the design of the wing makes moderate speeds more economical.

The Blackburn Company is accordingly proceeding with the construction of what they have named their fourton Pelican aerial lorry, a machine capable of carrying a load of nine thousand pounds. The weight of the tramp itself, with fuel, will be fifteen thousand pounds. The span of wings will be 146 feet and the body will be 84 feet long and 14 feet diameter over fuselage. The two engines will be of 900 total horsepower, the cruising speed 72 miles an hour, the landing speed 55 miles an hour, and the rate of climb 410 feet a minute.

Radical departures are made from orthodox design. The pilot's cabin is situated in the nose of the fuselage. Behind it is the cargo space (seventeen hundred cubic feet) and behind that the engine-room. The pilot's cabin will be hinged so as to swing right open, and the cargo—which will be scientifically packed in containers and carried upon trolleys on rails—will be run out bodily. It is estimated that the cost of freight between London and Paris will be only five cents a pound. If that figure is correct, there should be a wide expansion of such traffic.

Photograph by Charles Curtis for the Popular Science Monthly

"The inventor can't do it all," says Edison; "you've got to change people"

Said M. . Edison, in an interview with James H. Collins for the Popular Science Monthly:

"Greater and greater production is the real road to general prosperity. The country that can lead in this matter will supply the world.

"This should be the job of the United States.

"The English, while fertile in invention, are extremely conservative. The Germans are more open-minded, but not particularly inventive—they are most successful in applying the inventions of other people. The French are inventive, but their industrial genius does not run to quantity production.

"We have gone farthest along these lines, but our conservatism is also great. However, spurred on by the necessity for replacing expensive labor with automatic machinery, manufacturers will be increasing output, employment, skill, wages, and standards of life.

Edison on Super-Labor-Saving Machines

Employers and employees are equally concerned in this question about which Mr. Edison has some decided ideas

By James H. Collins

UPON every factory payroll there are two competitors in keen rivalry to see who can work the cheaper.

One is Wages, and the other Interest.

Interest has certain advantages over Wages. An automobile factory, say, requires three hundred fenders a day. Hand production of one per hour per man, with a ten-hour day, would require thirty sheet-metal workers. At five dollars a day per man, the labor cost would be $150 daily, or $45,000 a year. By investing $50,000 in a special forging press, turning out the same number of fenders, two or three operators could be employed at ten dollars a day each, and the yearly labor cost cut to $20,000, allowing for depreciation, wages, power, and so forth. Already there are such great presses in automobile plants.

Dollars can usually work cheaper than men, yet Wages has a curious advantage over Interest. For if the employees of the United States Steel Corporation put one tenth of their wages into the common stock of that company, within eight years they would own a controlling interest. Following the same plan, the railway workers could acquire a majority of the common stock in the railroads in twelve or fifteen years.

What High Wages Cost

Wages have been at record-breaking heights. There was talk of the ten-dollar-a-day workman. Not a few authorities believe that wages will stay approximately at these high levels.

If everybody can be employed at war wages, and production costs still be kept moderate, the result will be increased purchasing power and comfort. But if higher wages continue without increased production, then purchasing power must be limited, for producer and consumer will simply be playing the game with counters having higher values marked upon them, but purchasing no more commodities. Idleness in a war-cost world is tragic to the ten-dollar-a-day workman, with food, rent, clothing, and all other necessities at abnormal levels. Many thousands of workers this winter can testify that idleness at ten dollars a day is different from idleness at three dollars.

High wages stimulate heavier investments in labor-saving machinery. Such machinery increases production, lowers costs, broadens purchasing power, and eventually increases the wages of employees, who, while fewer in number, must have greater skill. Wages and living standards are highest in countries with the largest investment in machinery, like the United States, and lowest in countries where machinery has not yet replaced human muscle.

Do present conditions point to a new era of invention? Will it pay to invent and install very complicated and expensive machines—devices costing a quarter million, a half million, and even a million dollars, and doing the work of hundreds, perhaps thousands, of men and women?

Meeting the "Wizard"

With these thoughts in mind, the writer went over into New Jersey to see an inventor whose work in the past forty years has probably done more to increase jobs, wages, the output of commodities, wealth, and comfort generally, than that of any other individual. Out of Edison's brain have come not only complete industries like electric lighting and power, but enormous expansion in human production, and enormously increased consumption of things as diversified as copper, coal, platinum, trolley transportation, building materials, real-estate values, wire communication, music, the art of the actor, and business correspondence.

At Edison's library, they were dubious about an interview. The "Old Man" had been working at a terrific pace lately, and was "jumpy." Somebody had seen him disappear in the direction of the laboratory around noon. It might be necessary to wait an hour, maybe longer. And a highly condensed interview was urged.

Within five minutes the "Old Man" turned up on his way to the library for data. His face looked drawn and his eyes tired. His clothes needed brushing and pressing; his old derby hat was dusty. While explanations were being made he had an absorbed far-away look; but at the bare suggestion of the idea his face lighted.

"I've been working at that for fifty years," he said. "But the trouble is, you can't get people to do it! We have in this country an enormous capacity to invent super-machinery. But our desire to install the device is very, very weak. Human inertia is the problem, not invention. Something in man makes him resist change. He clings to his old equipment, and processes, and habits, rather than scrap them for something ten times more productive.

"Now, that probably sounds as if I meant the wage-earners who feel that new inventions will take their jobs away. But I mean the manufacturer too. It is just as hard to change him."

As an illustration, he went back to his automatic telegraph, which in the seventies scared British post-office officials with its prospect of one thousand words a minute.

"In London I met an operator who asked me if I knew his brother in New York. We had worked together. 'I'd like to have a word with you, but not here,' he said. We went out to a beer saloon.

"'They've put up a job on you,' he told me. 'They don't want your system to succeed, and are going to give you the old Bridgewater Canal line to Liverpool, which is never used now. If it has one leak it has fifty—I don't think you can get a message over it at all.'

"Well, the only answer to that was to use a very strong current. Remember, there were no dynamos then—electricity was still in the battery stage. At Apps' in the Strand—famous instrument-maker, you know—I found a big battery that Tyndall had used in his Royal Institution work. It cost a sovereign a cell and we needed one hundred cells. Five hundred dollars was a lot of money then, but my backer was game. We put that battery on the Bridgewater line.

The Unpaid Bill

"We sent one thousand words a minute without a hitch—perforated paper—came out beautifully, without an error, clean and black—no, blue. The trial was repeated—perfect transmission. That battery jumped all the leaks and stood up for half a dozen tests, and had plenty of power left at the finish."

Edison chuckled over this defeat of red tape nearly half a century ago.

"They adopted it eventually," he added, "but from that day to this we have never received a penny from the British government—not a cent!"

Edison maintains that we haven't begun to utilize our opportunities.

"We had few automatic machines in the seventies and no very big ones," he continued. "But there was one invention that embodied the whole principle of large-scale automatic production—the Jacquard loom. It has been turning out beautiful fabric patterns for more than a century. In purely automatic mechanism a supreme achievement, tremendously

complex, yet absolutely practical. Once a pattern is set on its cards, the Jacquard loom will turn out that pattern over and over again, as long as you supply material, power, and upkeep, to the end of time. But applications of the Jacquard perforated card principle to production in other industries are so limited that you could probably count them on your fingers. Other basic principles are cams on shafts, the pantograph as applied to the eccentric lathe, the drop press, rotary press, special drill jig, the grinding method of removing metal, and so on. All the inventor need know is what you want to do, and how much of it you have to be done, and he can furnish automatic processes and big-scale mechanism. Sometimes the problem will be worked out on mechanical lines, again electrical, again chemical. New principles will be found, of course, but those already available would keep the inventor and designer busy making new applications if invention were the whole problem. But it isn't. Human inertia is the problem—you can't get people to see the point!

A Government School

"More machinery, bigger, more complex, more automatic—why, that is so important that I think the United States government ought to found an institution — The "Government School of Automatic Machine Designing." The best brains available should be put to work. And there ought to be a fool-proof system of questionnaires for weeding out the unimaginative.

"What line will invention take?" was asked. "Will the new machinery be big, complex, costly? If we have factories installing million-dollar machines, won't that make the billion-dollar corporation obsolete?"

"It depends on the industry. When automobiles are turned out by the thousand, special machinery is possible. Cost of equipment is not important if you have volume of output, because interest is cheaper than wages. Suppose an automatic machine costing $1,000,000 displaces 1000 mechanics. At $50-a-week wages per man, that saves $2,500,000 on the payroll. At 6 per cent, your million-dollar machine costs only $60,000 a year for interest, and $200,000 depreciation on a life of five years. Lump interest, depreciation, upkeep, and operation together at $500,000 a year, and you have saved the cost of the machine the first six months. When you remember that such a machine may also double or treble production, it might be economy to replace even one hundred mechanics with a million-dollar machine."

"Will present high wages hasten investment and invention along this line?"

"I hope so, but I am also skeptical. Wages are certainly high enough today, and skilled workers far from plentiful. That may play its part in appealing to the imagination of the manufacturer. But it also increases the opposition of the worker, who naturally fights harder to keep a hundred-dollar-a-week job than one at twenty-five dollars a week. Automatic machinery is just as profitable and desirable when normal wages prevail. Why, automatic machinery in most industries would do away with ninety workers in every hundred. That sounds cruel, doesn't it? Labor fights the suggestion everywhere. But automatic machinery will benefit labor, both in earning power and commodities. If machinery supplants nine men out of every ten in a given industry, what happens first? Each man kept on the payroll can earn higher wages, because more skill is required to operate the more complex and costly machinery. Then production increases, goods are cheapened, more of them sold, and more workers employed. Show me a work-force of 10,000 men, and I'll show you 4000 or 5000 who ought to be retired. In 10,000 families there are probably 5000 persons who should not be working, but enjoying life instead. They can't do it now. Automatic machinery will let them do it."

"What can workers do to prepare for such changes in industry?"

"Many things. They might acquire technical knowledge and be ready to qualify for the better jobs made possible by the automatic machinery. Even more to the point would be acquiring an open mind and broad viewpoint. Instead of a job and a trade, something learned once and made to last a lifetime, the worker should be prepared to see his work change again and again in a lifetime. But it is hardly fair to expect that of employees when so many employers fail.

"It is a job for the salesman as much as the inventor. Markets must be expanded so that they will take commodities in unheard-of quantities, and justify big-scale production.

Every increase in production, every new invention, like the automobile, increases jobs and purchasing power. Greater and greater production, with abundant commodities for everybody, is the real road to general prosperity and a higher standard of life.

America's Job

"The country that can lead in this matter will have the job of supplying the world. It should be our job. The English are extremely conservative, and while they learned to talk of quantity production during the war, there has not really been any great change, although they are fertile in invention and research. The Germans are more open-minded, but not particularly inventive—they are most successful in applying the inventions of other people. The French are inventive, but their industrial genius does not run to quantity production. We have gone farthest along these lines, but our conservatism is also great. If high wages continue, and force us to think harder, and improve our methods and increase output by new, large-scale devices and processes, that will be a good thing. Spurred on by the necessity for replacing expensive labor with automatic machinery, manufacturers will be increasing the output of commodities, increasing employment, skill, wages, purchasing power and general standards of life."

"You Can't Get Men to See the Point," says Edison

"IT'S easy to invent, but hard to change men," says Edison. "Human inertia is the problem to-day—you can't get men to see the point."

"Will present high wages hasten investment and invention?" asked Mr. Collins.

"I hope so, but I am skeptical. Automatic machinery in most industries would do away with ninety workers in every hundred. To prepare themselves for such changes in industry, workers should acquire an open mind and broad viewpoint toward the modernization of industry. Instead of acquiring a trade, the worker should be ready to see his work change again and again in a lifetime."

This is James H. Collins, who interviewed Mr. Edison for Popular Science Monthly

A Paper Suit for One Dollar

Making a virtue of one of the war's necessities

By Dr. I. Newton Kugelmass

PEOPLE are wearing paper clothing and even paper boots, in Argentina, Austria, Germany, Great Britain, Italy, and Turkey. The style originated in Austria and Germany, where one can buy a workman's suit for 58 cents or a regular suit, machine-tailored, at from 29 cents to $2.50, an overcoat for 51 cents, a pair of boots for a quarter, and a hat for a dime.

Germany had to avoid nudity when she was cut off from overseas supplies of cotton, wool, and hemp. The only available raw materials were paper and cellulose fiber. So there was nothing for it but to wear paper.

As a matter of fact, not only are clothes made from paper, but several hundred other commodities of daily use. Apartments can almost be furnished with the paper goods appearing in foreign markets now: towels, quiltings, upholstery goods, bed- and table-linens, curtains, sewing-threads, sacks, overalls, raincoats, collars, embroidered blouses, hairpins, hangings for walls, imitations of Persian carpets, and even horses' harness and piping for oil and gas.

All of these materials are made from so-called paper yarn—in reality cellulose, which makes up the framework or structure of all vegetation.

In making paper yarn, the cellulose is transformed into paper, or old paper is used. The manufactured paper rolls often weigh as much as eight hundred pounds. They are cut into narrow strips from one eighth inch to six inches wide. These strips are tightly wound into disks.

Twisting of the strips into round threads is next in order. The German method is this: The disk is contained in a flat holder and the stripped paper is twisted by two small rolls above the disk. Then the twisted yarn is wound on spools. Sometimes the paper yarn is moistened to make it pliable for twisting, and chemicals are added to give the finished product flexibility, pliability, and durability.

The greatest care is exercised in controlling this twisting process. If there is too much tension, the yarn tears; if there is too little, the product is irregular. Therefore the twist gearing is continually readjusted to give the right amount of twist.

After twisting, other fibrous materials are woven in. Wastes from cotton and flax are introduced in paper thread. To increase its resistance and to waterproof it, the yarn is automatically passed through a warm bath of mixed glue, tannin, and water glass. Then it goes through a cold bath of aluminum formate and is dried immediately. This treatment does for paper yarn what tanning does for the skins of animals.

Paper clothes can be washed with hot but not with boiling water. They cannot stand machine laundering but must be hand cleaned or brushed. Acids ruin them; alkalis agree with them. They cannot go through a wringing process but must be allowed to dry out. They cannot be mangled. They will stand pressing, but it is safer not to iron the borders and folds. On the average, a piece of paper goods or a suit can be washed twenty times.

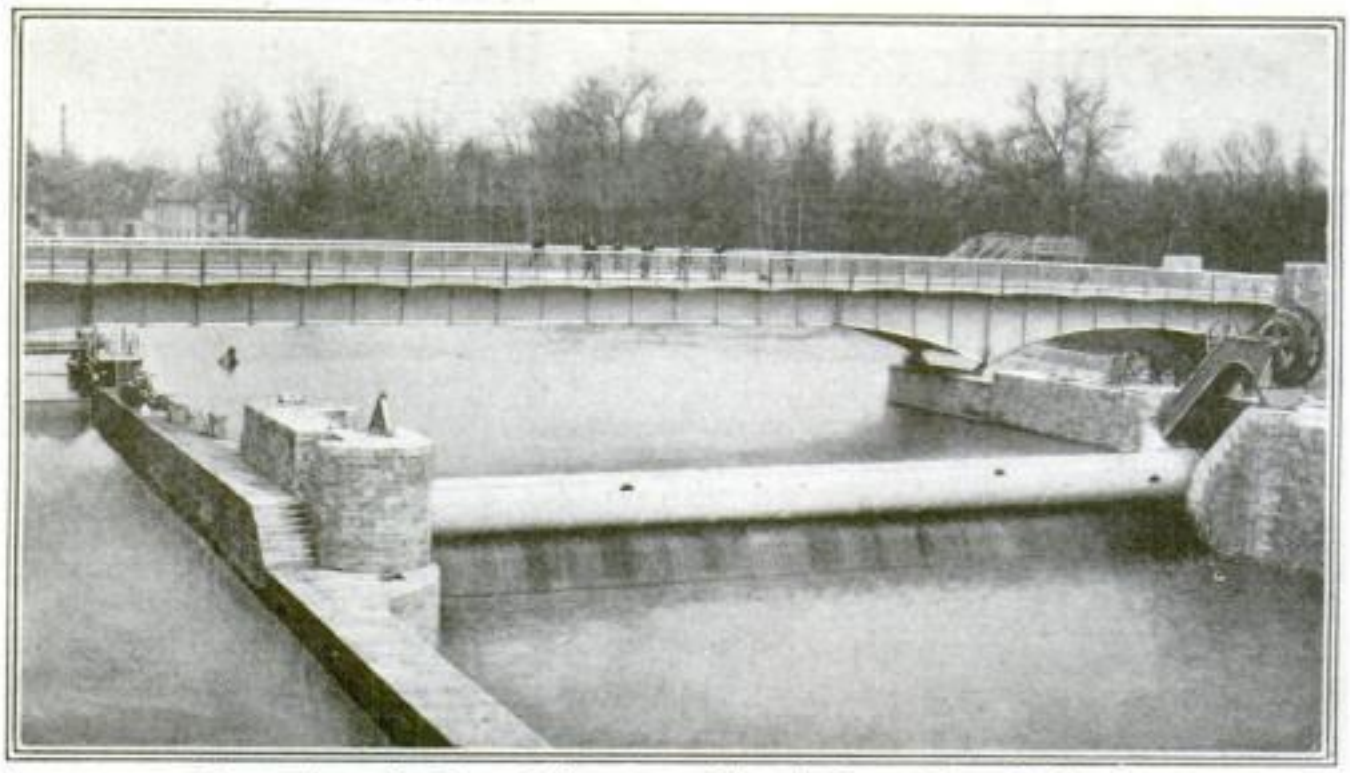
One hundred million pounds of paper fabric is being manufactured annually in Germany. England is making paper yarn with American machinery. France makes a paper for clothing as well, but it is backed with cloth. Japan is using paper for straw hats, for filling silk, and for making thread. Most Japanese paper yarn is made from bamboo paper. Finally, Sweden and Denmark are just starting in the paper goods business.

What Austrians Pay for Paper Clothes

	Cents
Cuffs	1
Collar	2
Workman's suit	59
Laundry-bag	19
Child's apron	22
Shopping-bag	14
Table-cover	42
Rain-hood	22
Hall rug	33
Man's suit	$1.40
Woman's apron	23
Window-curtains	46
Shop coat	47
Overcoat	50
Linoleum (sq. yd.)	33

© Kadel & Herbert

He looks fairly well dressed and comfortable in his paper suit, and his paper overcoat looks warm. No doubt there is a large percentage of the same material in his brief-case and shoes



To regulate the flow of the water, this tubular weir is raised or lowered by a movable member operated on shore

This Big Pipe Regulates the Flow

WEIRS are placed in rivers, canals, and other natural or artificial water-courses to regulate the water-level in accordance with requirements. Emergencies like floods, freshets, and ice blockades call for an immediate change of water-level. In such cases most of the known types of weirs fail because they are too complicated to operate.

A striking exception is presented by the tubular weir, a recent invention that has proved its merit under severe tests. That shown in the illustration is not the largest.

The movable member of the weir is a tube of riveted steel or iron plates. Its length depends on the width of the river or canal, and its diameter on the height to which the water-level is to be raised. This watertight tube may be raised or lowered by a chain which engages sprockets in a band that encircles the tube at one end. The tube is rolled up or down an inclined bed in the masonry of the land support of the weir, either by hand or by motor. Both ends of the tube have gears that engage racks on both sides of the weir

An Old Iron Raven that Comes from Japan

THIS is not the famous raven that perched itself on Edgar Allan Poe's door and quoth "Nevermore." It is a less famous raven that is perched on the floor of a glass case in the Metropolitan Museum of Art, New York city, and says nothing. There is a very good reason: the raven is of iron.

It is more than two hundred years old, and has traveled all the way to New York from its native country, Japan. A Japanese artist in iron, Myochin Shikibu Kino Munesuke, designed and made the raven, and then signed his name in Chinese characters under the raven's tail.

Courtesy of the Metropolitan Museum of Art

This iron raven is two hundred years old, and comes from Japan

Munesuke was a descendant of a well known artist armorer who lived in the twelfth century, and he himself made many pieces of armor.

Japanese artists who work in iron use no polishing processes at all to improve the finish of their work; yet they will often cut their lines to a uniform depth and fill them with gold and silver.

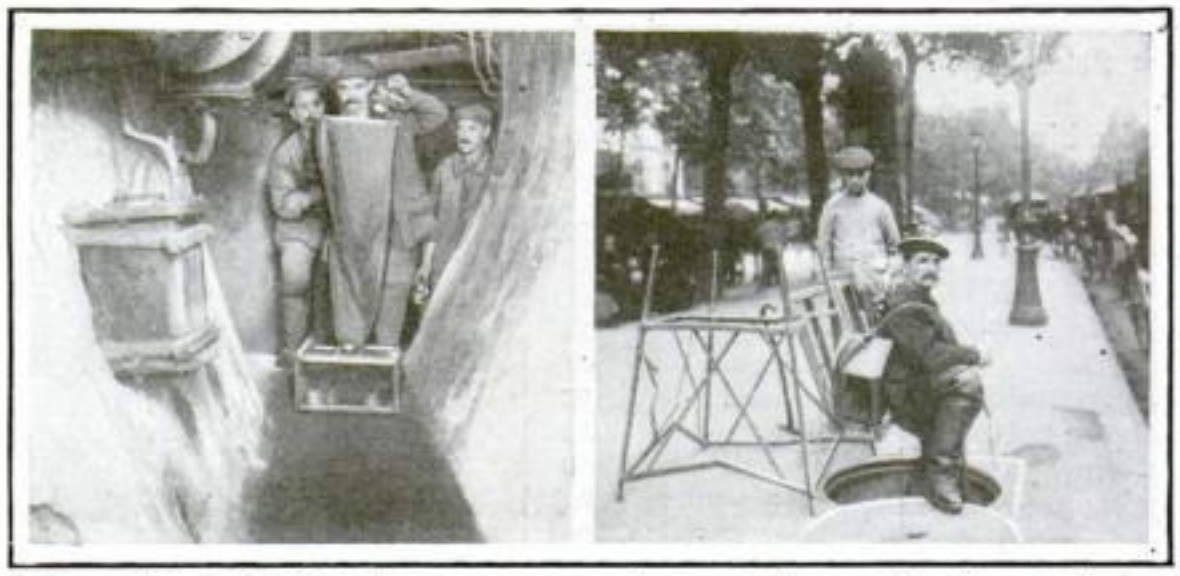
How Paris Is Making War on the Rat

DURING the world war, which disorganized all branches of public service in the belligerent countries, it became impossible, among numerous other things, to continue the warfare against the rats theretofore mercilessly conducted in all civilized countries of Europe. As is well known, the rat is extremely destructive and is known to be the carrier of dangerous parasites and of even more dangerous disease germs. In consequence, its enormous increase became a public menace, requiring immediate attention.

In France the situation became critical when sporadic cases of a disease, strongly suspected as being the bubonic plague, were discovered in Paris and some of the large seaport cities. The authorities recognized the absolute necessity of energetic measures, particularly in the large centers of population, for the complete extermination of the rat.

The municipal council of Paris, urged and vigorously supported by the health authorities, met, and after a thorough discussion of the problem declared war against the noxious rodents. An appeal to the public was issued which asked all citizens to assist in the war of extermination by providing covers for all garbage receptacles and by catching and destroying as many rats as possible.

As an incentive to more vigorous effort in the destruction of rats, the city authorities offered a premium of twenty-five centimes for each rat killed and delivered to the proper district officials. The dead animals collected at the different district stations are sent to a central station, where they are cremated. Rat-killing is now a popular sport in Paris.



Emptying a bagful of rats, preparatory to carrying them to the street

A twenty-five-centime bounty has sent Paris huskies into the sewers to hunt for rats

Would You Sing?

Then you must first learn to breathe properly

AN inventive singing teacher has finally given to the world a mechanism that will perform the most trying labor of singing lessons. Not only singers but public speakers will be benefitted by this new invention, while the number of cases of pneumonia, influenza, consumption, and other diseases brought about by incorrect breathing will be reduced to a minimum.

The inventor is Professor Bertrand de Bernyz, a voice specialist of New York city, and the mechanism, which he recently patented, he calls the oxygen indicator. The apparatus indicates the lack of oxygen in one's system, increases by proper diaphragmatic breathing the amount of that oxygen, strengthens and develops the lungs, increases the stock of vitality and mental energy, dislodges many of the germ pockets, and lessens the danger of germ development.

Professor de Bernyz realized that improper breathing interfered with the development of singers. He has devoted the best part of his life to the perfection of a machine that would point out and then remedy faults in breathing.

The machine in itself is simple and will fit into the pocket. It consists of a band fastened taut around the waistline and connecting with a dial. As one inhales deeply, the pressure of the abdomen against the band causes the dial hand to move across a series of figures. The figures indicated show just what amount of available space for oxygen one has in one's system.

When there is a lack of oxygen space indicated on the dial, the pupil knows that he must undergo certain calisthenics to develop the diaphragm. By consulting the oxygen indicator he may see what progress is being made toward the improvement of his breathing system.

"Every one should be capable of drawing in and maintaining two cubic inches of air for every pound he or she weighs," Dr. de Bernyz claims.

"People do not breathe deep down. They try to reach high notes or to hold notes when there is no air in the stomach. The human body is made up of organs for breathing purposes that are never utilized. Most people sing from the throat and not from the diaphragm. If they would breathe properly, they would at least learn to use the physical apparatus that nature gave them."

In this picture Professor Bertrand de Bernyz is demonstrating his voice-culture apparatus. The center picture shows the instruments measuring how deep a breath the man is taking

Other parts of the apparatus. Professor de Bernyz declares that few people breathe deeply enough; that we should inhale two cubic inches of air to every pound of our weight, filling our stomachs as well as our lungs

Can you draw, rapidly, a continuous line between these parallel lines without touching them? If so, you are efficient

A Psychological Test for Speed and Accuracy

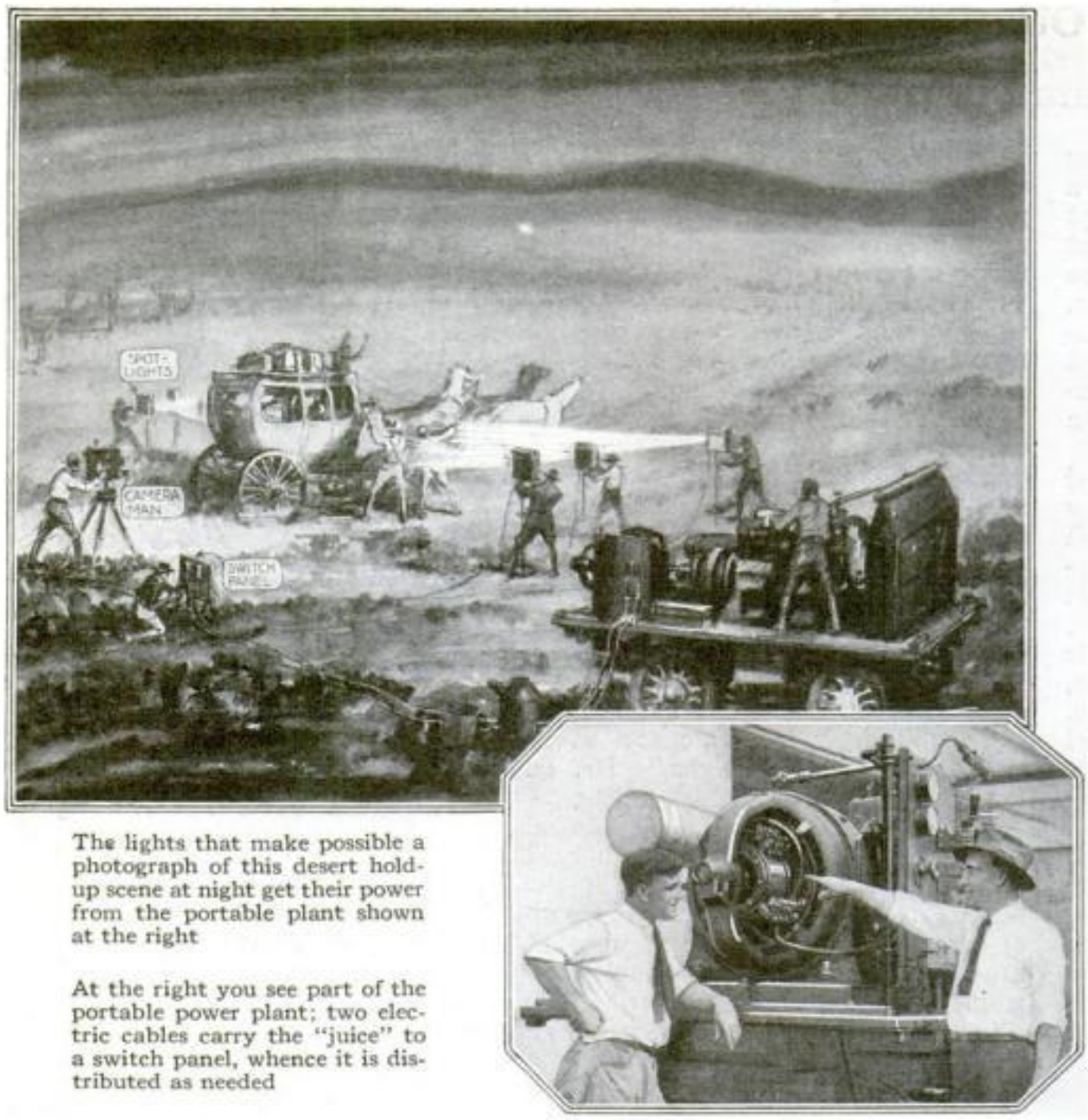
TAKE a sharp pencil, place the point between the two parallel lines in the lower left-hand corner of the "maze" above, and draw, as rapidly as you can, a third line. This line must not touch either of the original lines, nor must you shift the position of the magazine or lift your pencil while you work. Keep a record of the time it takes you to complete a trip around this very complicated design.

Such is the Thorndike "maze test" used in many schools for determining the drawing speed and accuracy of the pupils. Speed and accuracy are the chief factors in efficiency, which is all-important in this twentieth century.

The children are given seventy-five seconds in which to work. At the end of that time the number of linear inches they have covered are computed and errors recorded. Some children are quick and careless, and others work slowly but accurately. Both types are given the proper instructions.

The test is given again an hour later. After five consecutive tests have been made, the records are tabulated by considering the average results of the first test as one hundred per cent efficient. This is used as a basis for the other tests that follow.

Results show that speed of movement increases steadily during the day. Accuracy, however, varies. It improves gradually till lunchtime. After lunch it declines. Is this not another indication of the fact that work done in the morning is apt to be more correct than afternoon work?



The lights that make possible a photograph of this desert hold-up scene at night get their power from the portable plant shown at the right

At the right you see part of the portable power plant; two electric cables carry the "juice" to a switch panel, whence it is distributed as needed

Taking Electric Light into the Desert

"THE Hold-Up at Night in the Desert" flashes on the screen, and then you see your favorites lose all in a real, true desert. If you are not too much affected by the touching scene, you may wonder how the proper electrical effects are accomplished in that spot in obvious darkness.

One large moving-picture company takes light to the desert by means of the portable power plant shown above. Two electric cables lead from the power plant to a switch several feet away. Here many wires branch out, carrying lights of varying power at the ends. Thus the "movie set" can be located at considerable distance from the power plant.

A few spotlights are usually focused on the scene being taken, and several broadside lights are lined up on either side.

Making Use of the Smoke of Walnut-Shells

CHICAGO packers boast that they use every part of the pig but the squeal. California walnut-growers burn the nut-shells for the charcoal produced and they also make use of the smoke.

Thousands of tons of nut-shells are produced every day and their disposition became a knotty problem. During the war, the shells were ground up and used as a hardener for explosives. With the advent of peace, this demand ceased and large quantities of the nut-shells accumulated. It cost too much to cart them away to the dump. "Why not burn them to charcoal and sell the product to poultry-food dealers?" some one suggested. This was a thought.

The walnut-shells are first placed into a large bin from which they are fed into a rotating gas-heated kiln, where they are burned to charcoal. The small black kernels produced sell for seventy dollars a ton.

The smoke and gases from the burning shells pass into a long iron flue where they come into contact with water spray. A heavy mist or steam is formed. A suction fan is placed at the end of the flue, which sends the steam and light gases up the stack, where they discharge into the atmosphere. The heavier particles, laden with creosote, denatured alcohol, acetic acid, and other compounds, precipitate into a receptacle at the base of the stack.

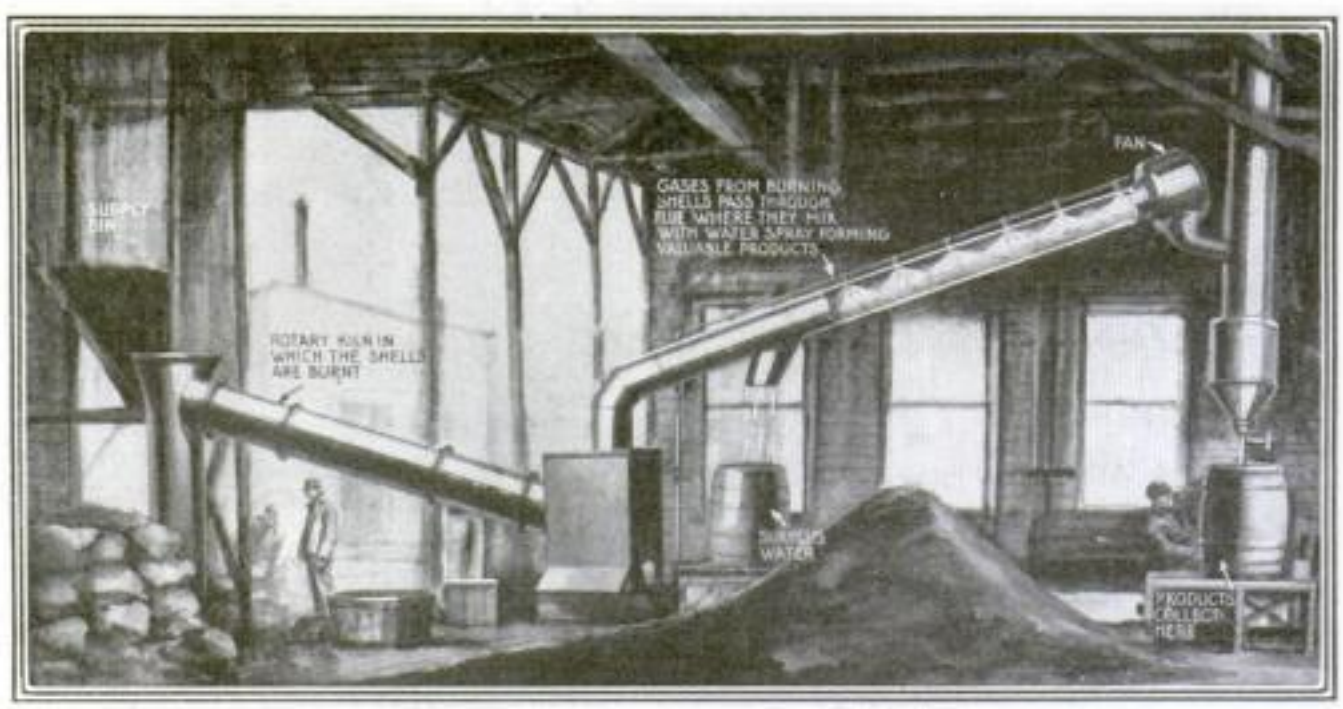
The process is continuous and it requires very little attention. Two or three men are able to handle many tons of walnut-shells a day. They not only earn their salary, but add a handsome yearly profit to the walnut-growers' income.

A Wild Airplane Ride through Omaha

WHEN a wild-eyed bronco-buster dashed through the streets of a Western city in the early days, the inhabitants scurried to safety. Now comes a man dashing through Omaha in an airplane.

For more than an hour he rushed down between buildings, and as a diversion did nose dives and tail spins at points only a few feet above the trolley-wires. His thrilling ride ended in the police court.

Nebraska has no ordinance regulating aerial traffic, so the aviator had to be tried under a law known as the "Runaway Team" law.

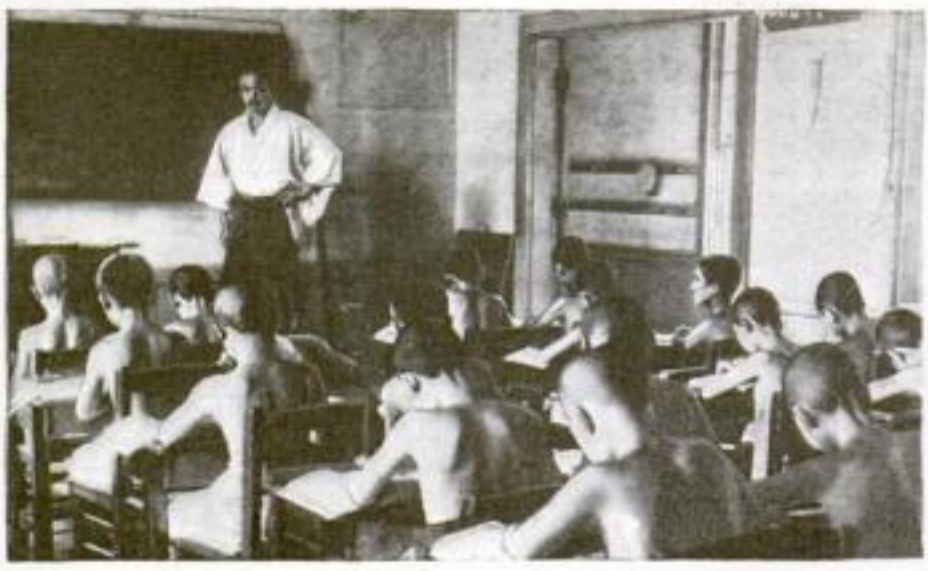


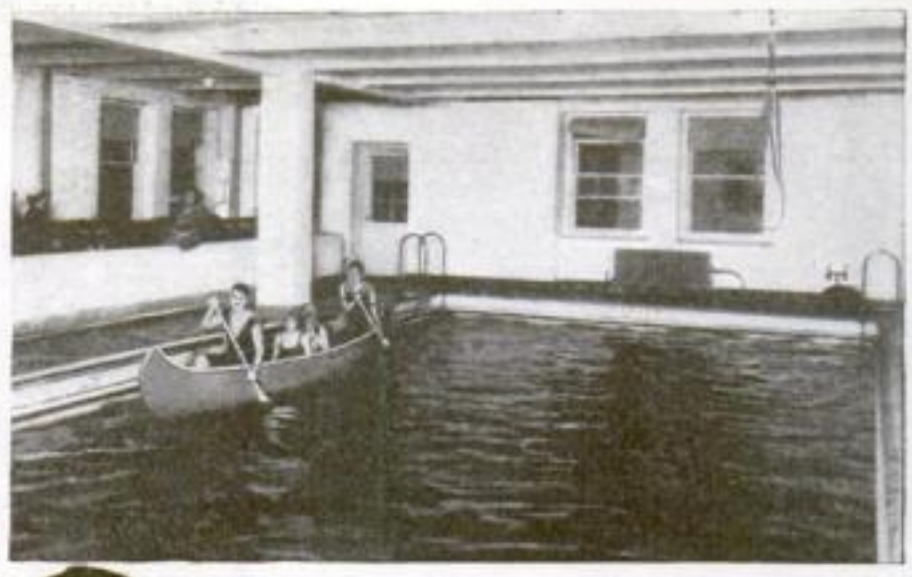
In California, walnut-growers are getting charcoal from burned walnut-shells; the small black kernels sell for seventy dollars a ton

Landmarks for the Aviator

STANDARD arrangement of landing-fields would be an advantage to the itinerant airman who flies at night and who comes down in a strange region. For instance, if the pilot knows where the radio tower is placed with relation to the airdrome, he would know at once how to avoid a possible crash in approaching the field in thick weather. Vertical and portable searchlights illuminating the field are indispensable.

Directing an airplane by wireless, the so-called "radio localizers" on the modern landing-field should bear a definite relation to the position of the airdrome. A plan suggested by the United States Air Service furnishes an ideal arrangement of these details. On one side of the airdrome is placed the meteorological and radio equipment structures, which project upward and obstruct a clear approach to the field. On the other side of the airdrome are the localizers and the fog-dissipation mechanism built underground, and the markers. Here nothing projects into the air to hinder low flying when looking for the landing-place.





Child Welfare in Japan

IN Japanese schools the physical development of a child is given as much attention as his mental development. On warm days he strips to the waist and his teacher watches him closely as he works. If he breathes improperly, he is corrected; if he is round-shouldered or flat-chested, he is given special exercises; if he is too thin for his height, a special diet is recommended.

In Japan, as in the United States, every child must go to school when he is six years old. He receives a six years' course in morals, reading, arithmetic, gymnastics, and poetry.

Lift the Records with a Suction Cap

ACCIDENTS will happen to phonograph records, no matter how carefully one handles them. Oftentimes a record is badly injured while being removed from the machine. This happens through the hand slipping and one of the fingernails digging into the soft surface of the record. The next time the record is played, there will be a *click-click-click* as the needle passes over this point.

A little rubber cap, attached to the phonograph by a spring, enables one to remove a record with but slight danger of an accident. It is simply pressed to the surface of the record. It grips tightly and lifts the record into the hand with an easy movement.

Canoeing in the Swimming-Pool

WE have indoor swimming and tennis in winter, so why not indoor canoeing?

In most winter pools there is nothing to do but swim. You can't lay yourself out for a sunburn, and if you try to play ball you will surely slip on the wet pavement around the pool. The women don't even have the pleasure of displaying their anti-wet suits.

But if there are a few canoes in the pool, there will be plenty of sport. Canoe hurdling, for instance, can be practised with entire safety. Even short races can be staged.

A New Garment for Surgeons

THE ghostly garments that surgeons wear when they operate are usually buttoned from neck to waist. The buttons are very apt to fall off at the wrong time and even at best they are annoying when a surgeon is in a hurry to get in or out.

A new type of operating garment has been invented recently by Mrs. T. H. Hinman, of Atlanta, Georgia. There are no buttons or hooks and eyes on it—two strips of tape that tie at the back hold the entire garment in place. The two front halves of the waist have extensions that reach around to the back as shown in the illustration. Why not make mechanics' clothes this way?

The Chef's Daily Manicure

ONE of the daily events in the life of a chef in any of the large New York hotels is his morning manicure. Before he touches food, his hands are carefully washed and his nails are cleaned, cut, and polished.

The job is not given to a sweet girl manicurist, but to one of the hotel physicians. He is always on hand during the day; should the chef accidentally cut himself, the doctor will bandage the wound, as he is there for that purpose.

Chefs are precious these days; many of the French ones—unable to get their daily bottles of wine—have gone back to France, where the thought of prohibition can still be treated as a joke, though even in France there are heard ominous rumbles between the jokes passed at our expense.

Wanted: A Substitute for Goldbeater's Skin

LARGE rigid airships, such as the R-34, which crossed and recrossed the Atlantic ocean in 1919, contain nearly a score of gas-bags filled with hydrogen.

Each gasbag is lined with goldbeater's skin, taken from a certain part of the intestines of a cow or ox. No other membrane answers so well in preventing gas leakage.

The intestines of five hundred thousand cattle must be handled, scrubbed, cleaned, and applied to line the bags of so big a dirigible as the R-34. The cost is about $200,000.

Here is a chance for a chemist to provide a cheaper substitute that is impermeable to hydrogen gas.

Keeping the Tracks Clear of Tropical Grass

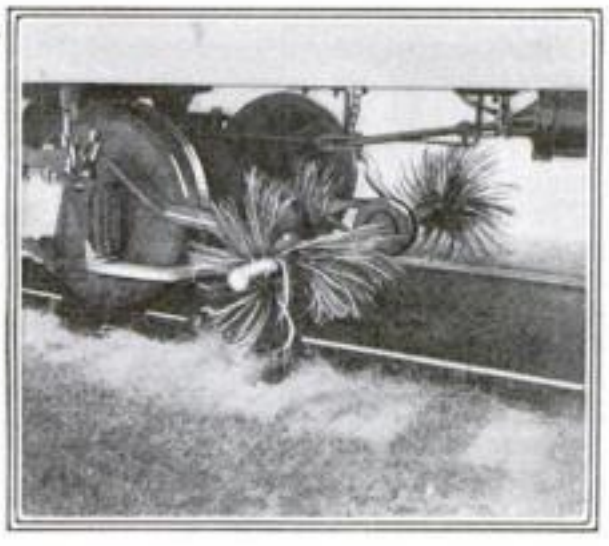
HERE is a rotating wire brush that can tear up the weeds and grass.

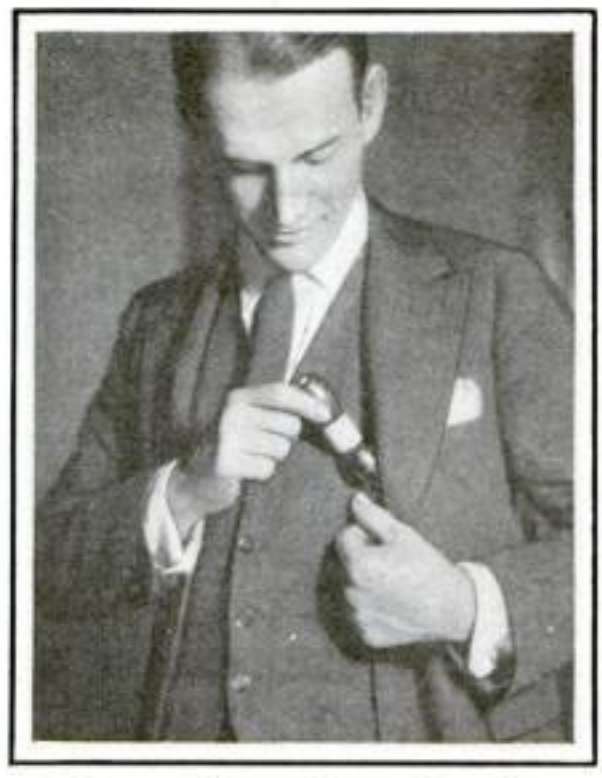
Bermuda grass is a tough tropical grass that grows along the railroads in Texas. It grows rapidly and it costs much to remove it. One of the engineers on the road hit upon the happy idea of attaching a wire brush to a number of cars. It proved very effective.

Four brushes are mounted upon a heavy shaft. This shaft is driven from one of the car axles by a belt. The pulley mounted on the car axle is large, so that the wire brushes reach a high speed even when the car is traveling at ordinary speed.

When the brushes are revolving at high speed, centrifugal force causes the strands of wire rope to stiffen.

The steel wires are so rigid that they are just as effective as solid steel rods would be, and the weeds are hit with terrific force.





Carry Your Own Punch

NEW and mysterious is the glass bottle that is shaped like an hourglass but that contains something much more energetic than sand. The contents are in liquid form, and when dumped into a bowl containing sweetened water will form the concoction known as orange punch!

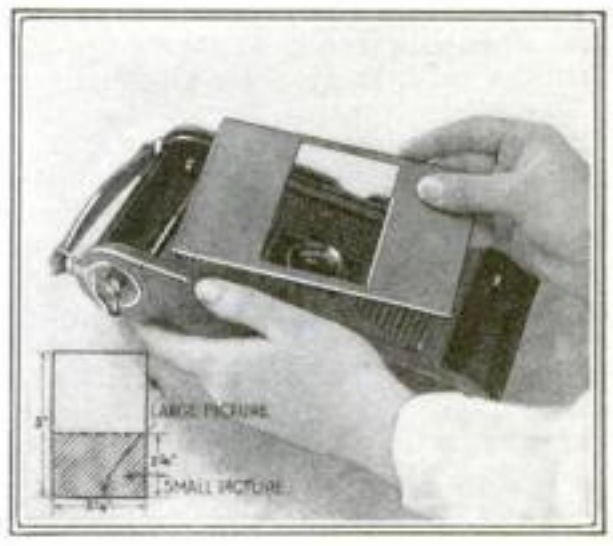
Each half of the glass bottle contains a separate liquid, and the two are kept apart by a cork placed between them. They do not come into contact with each other until they are dropped into the water simultaneously.

You might get one of these bottles and, if you are not partial to orange punch, fill the orange end of the glass with some other flavor.

Two Sizes of Photographs with One Camera

IT is a simple device that enables the photographer to adapt his camera so that it will take two sizes of pictures. A stiff paper mask is fitted inside the camera, between the lens and the film, while a small mask of the same proportions and covering the same field is fitted over the finder.

A cogged wheel having numbers near its rim is arranged on the outside of the camera's side, so that it engages the attachment of the film-turning device. These numbers are so spaced that they indicate exactly the section of film that occupies the position exposed to the lens. In this way a film 3¼ inches wide, taking six pictures normally 5½ inches long, can now include thirteen pictures 2¼ by 3¼ inches. This is a convenience to be appreciated by one who likes to use his camera for large as well as small photographs. When he can take thirteen pictures instead of six, there is considerable economy to his advantage.



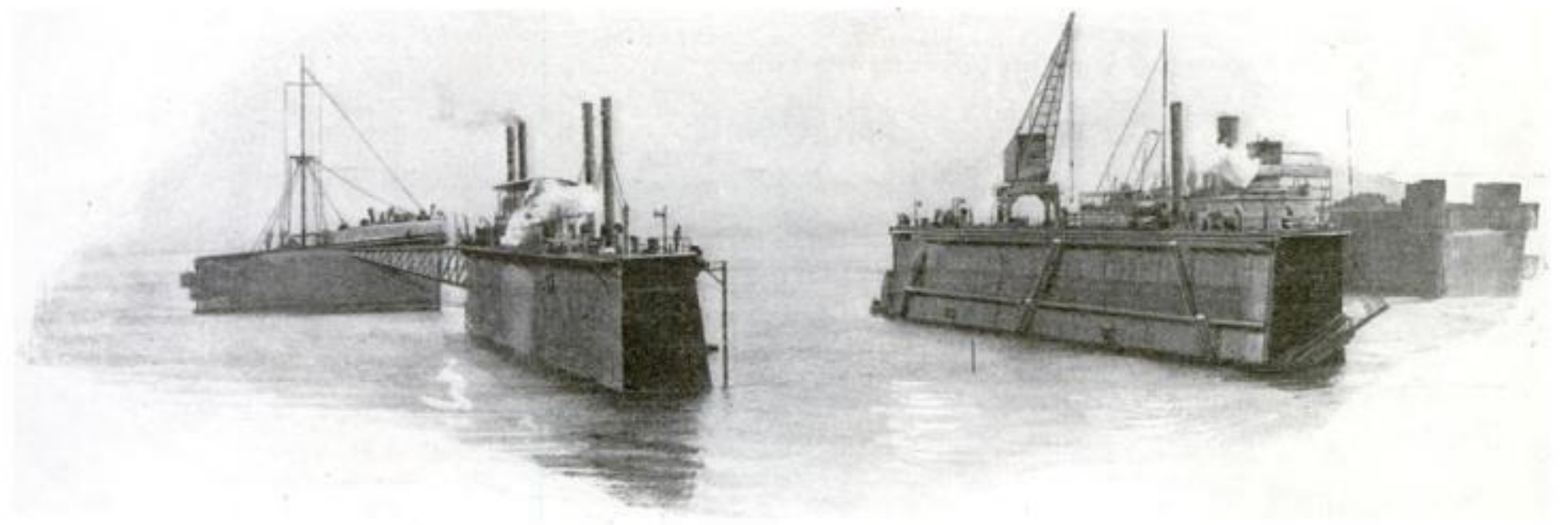
This Ship Traveled to Its Destination in Instalments

THE *Canadian Runner* was constructed inland for use on the seas. After she was put together at Port Arthur, Canada, the engineers were confronted with the problem of floating her to the ocean, since the locks along the Lachine canal, which parallels the St. Lawrence river, could not accommodate such a large boat. The boat was cut in two, tightly boarded up, and towed to the Atlantic ocean, where she was reassembled and made ready for her first trip on the briny deep.

The reader will probably look upon this work with the thought that it involved a great outlay of money and labor. It really did necessitate considerable labor and expense, but not nearly so much as the average man would believe. The steel plates of the ship were merely unriveted in a floating drydock, and the ends of the two halves were carefully boarded up with two-inch planks. All of the cracks were filled up and water was allowed to enter the drydock. The two halves of the boat were then pulled out by attending tugs. The tugs also pulled the divided vessel through the canal.

At the opposite end of the canal another floating drydock was brought into use and the two parts of the vessel were placed in it. When the water was pumped out of the dock, the planking that covered the ends was removed and the rivets placed. In a short time the vessel was ready for service.

During the war Canada cut several ships in two in order that they might pass through the Lachine canal locks.



Basketball en Route

WE'VE had so many parades in the past few years that a parade must now be very unusual to attract attention. Thus when the boys' clubs of San Francisco had a parade recently, they provided plenty of entertainment for the watchers.

Two picked teams played basketball throughout the entire line of march. Their goals were carried by two large motor-trucks, which moved slowly at the sides of the street. Only the truck chassis was used in each case, and the baskets were mounted on wooden frames. The people on the sidewalks were well able to see the spirited game. The idea was novel, but history says nothing of the disappointed ones who just missed seeing a goal won.

The Self-Loading Hand-Truck

VERY often the assistance of an extra man besides the operator is required to load a hand-truck. To avoid this, a truck has been invented that permits the loading of any reasonable weight by one man.

The truck is placed upright close beside the article to be loaded. A long adjustable lever, which can be raised or lowered, lengthened or shortened, by means of teeth on its lower edge, extends from the truck's only handle, and grasps the article to be loaded by means of a hook on its further end. One foot is placed on the lower part of the truck, the handle is pulled forward, and the truck is loaded.

Wait on Yourself and Prosper

YOU want a loaf of bread, and you want it in a hurry. But when you enter the bakery, there are several people before you and you must wait impatiently till your turn arrives, or even longer, if the autocrat behind the counter happens not to like your looks. That loaf of bread you want is within your reach. If only you could pick it up and pay the cashier!

That is exactly what you can do in the new self-serving stores that are being introduced all over the country.

The merchandise is displayed on a series of shelves between which there are connecting aisles. You walk through the aisles, gather in the goods you want, and then proceed to the cashier's desk.

A Tilting Reel for Wire

IF you have wire to wind or unreel, this tilting reel will solve your problem. Every one who has had occasion to handle wire knows how easy it gets tangled up into a hopeless mess.

This reel is double-jointed throughout, and it can be placed in any position. When a heavy coil of wire is to be placed upon the reel, the reel is tilted over and labor is saved.

The heavy counterweight at the lower end of the shaft on which the reel revolves helps the workman to throw the reel back into position. The pegs on the reel are adjustable for different sized coils.

Whatever position is desired, the reel is so perfectly balanced that it will never be out of the operator's control. Altogether it is a rare combination of safety, convenience, and economy.

The Smallest Automobile

COMPARED with the tiny car in which Miss Ula Sharon, a New York actress, travels up and down Broadway, the "flivver" is a monster. When she arrives at the theater she doesn't park her "roadster" outside. Not at all; she drives it right into her dressing-room.

It is so small that if Miss Sharon should get careless and gain a few pounds in weight she wouldn't fit it. The car gets its power from a storage battery and will go ten miles before it needs recharging.

With such a tiny car she can work her way up to the front ranks when a policeman holds up traffic and thus beat out the large, powerful automobiles.

It's Small but Husky

THE implement shown below is a jitney in every sense of the word. It costs only five cents an hour to operate, and it will do many different jobs—plow snow, pull logs, and haul wagons around the yard of a factory. It will also saw wood, run an electric generator to light a farm-house, or pull a cultivator through a truck-garden. It is a gasoline jack-of-all-trades.

It is controlled through the handles in much the same way that a motorcycle is controlled. It rolls along at a comfortable pace even when it is working hard.

Typewriting Helped by the Feet

A TYPIST who prefers to use his foot instead of his hand in drawing back the typewriter carriage at the end of a line can use the invention of Edward A. Pfefferle, of Burley, Idaho.

A telescopic rod on top of the desk connects with the typewriter carriage and operates without springs. The foot operates the device in both directions, pressing down with the toe when drawing the carriage toward the right and spacing lines, and pressing gradually downward with the heel as the writing proceeds to the end of a line. When pressure is placed upon the heel-end of the foot treadle, the rod telescopes and gradually extends as the typewriter carriage moves toward the left.

A Ship Designed for Stability

SINCE the great concrete ship *Faith* was constructed several years ago, a number of experimental vessels have been produced. Here is one of the latest, made in Denmark.

The good ship *Bartels* may be seaworthy and staunch, but she has very ugly lines, as a glance at the photograph will show. Her design would please a cubist, but an ordinary human being can see nothing beautiful about her.

The engineers who designed the *Bartels* gave her this peculiar shape to make her stable while at sea. She is of reenforced concrete, which, her makers say, makes her practically unsinkable. Whether or not their theory is correct is not known, since this fond child of their brain has not as yet had a taste of the briny deep.

It Locates the Trouble with the Telephone Wires

EVERY city has its network of wires, and it keeps many linemen busy the year around to maintain the service.

Toll lines often have an earning power ranging from thirty to one hundred dollars an hour, which means a big loss for every minute the line is unnecessarily out of order.

Linemen with ordinary talking sets are unable to make specific locations of trouble, and must be guided entirely by a test man at the wire chief's office. Furthermore, when a lineman calls in for tests, he ties up another circuit, making a loss appear on two circuits—the one he is hunting trouble on and the one he is getting instructions over.

This trouble-finder is designed to lead the lineman directly to his trouble. He does not have to cut any wires but simply follows a small "finder coil" in the set until he comes to the point of trouble. In this way sometimes hours of time are saved, a big item to telephone companies.

Comfortable Working Chairs

THE factory worker is coming into her own at last. Rest-rooms and lunch-rooms have made her life easier; and now Mr. William J. Koch, of La Crosse, Wisconsin, has invented for her an adjustable back-rest that will make her chair as comfortable as any.

It is made of spiral springs, covered with canvas, that are firmly held by brackets attached to the back of the chair. The brackets can be adjusted to any width or height to suit the particular girl who uses them. As she leans back the springs support her yet give her plenty of leeway. She is not apt to suffer from an aching back and the fatigue that usually accompanies it.

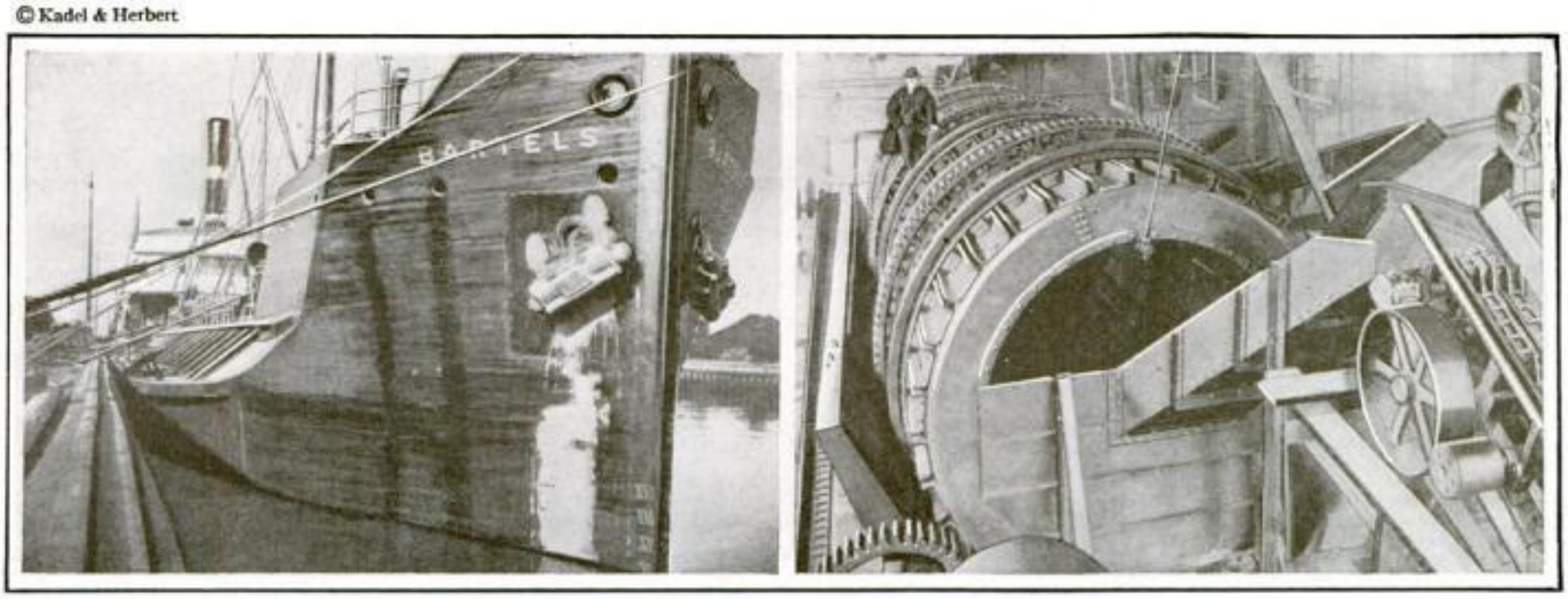
Barking the Logs—How It's Done

BEFORE logs are ground for wood-pulp, the bark must be removed. In large paper-mills, where thousands of logs are handled daily, a very efficient process is used in the removal of the bark.

The giant machine here pictured is used for that purpose. The logs are brought to it on mechanical conveyors. When the drum is full, an electric motor turns it, and the great friction between the logs tears the wet bark from the surface and they come out of the barking-drum clean and ready to be ground up.

A single drum can handle several thousand cords of wood in one day. After the bark is removed, it slips out between the section.

The barking-drum is of the continuous-feed type.

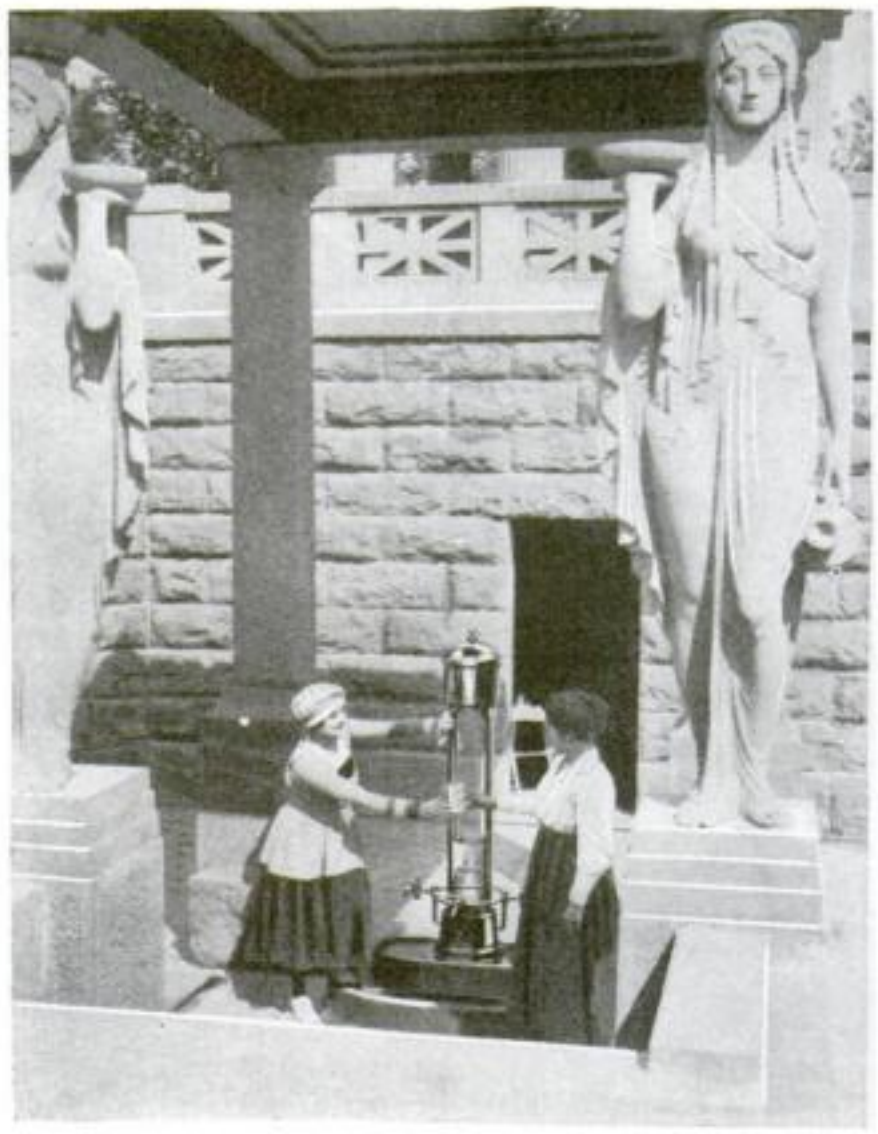


A Comb for Your Watch-Chain

"SILVER threads among the gold" has a new meaning. The silver remains the same, but the gold is represented by a comb with a gold back that fits in a gold case. And the case hangs at the end of a watch-chain.

The fit is a close one, and there is no chance of the comb's slipping out of its case, thus revealing its identity. Since it is about as long as your finger, it is no more conspicuous than a pencil dangling at the end of the chain.

In the illustration above you see one of these combs in operation. Note how the case serves as a handle.



The Town Pump Rebuilt on Scientific Lines

WHERE there is no running water and where the old-style rural pump was required to draw up the water from the well, this new type of pump has been installed.

In a clear glass tube from which the air has been extracted, the water is forced into the vacuum by the pressure of the atmosphere. As one turns the faucet and runs out some of the water from the tube, the water from the well is sucked back into the tube until a certain limit is reached, on the same principle as that which operates a siphon.

How much easier is this method of getting water instead of the old way of tiring one's back by working the pump up and down, or of having to draw the water from the well with a rope and bucket, not to mention the greater cleanliness.

Modern thought appears to be devoted to labor saving, either to enrich the manufacturer or to help the housewife.

This Little Hen Broke the Record

THE spectacular Babe Ruth has many namesakes in all walks of life. One of them is a white Leghorn hen! But she didn't receive that name for any "home run" proclivities; on the contrary, she remained close to the chicken "run" and laid eggs.

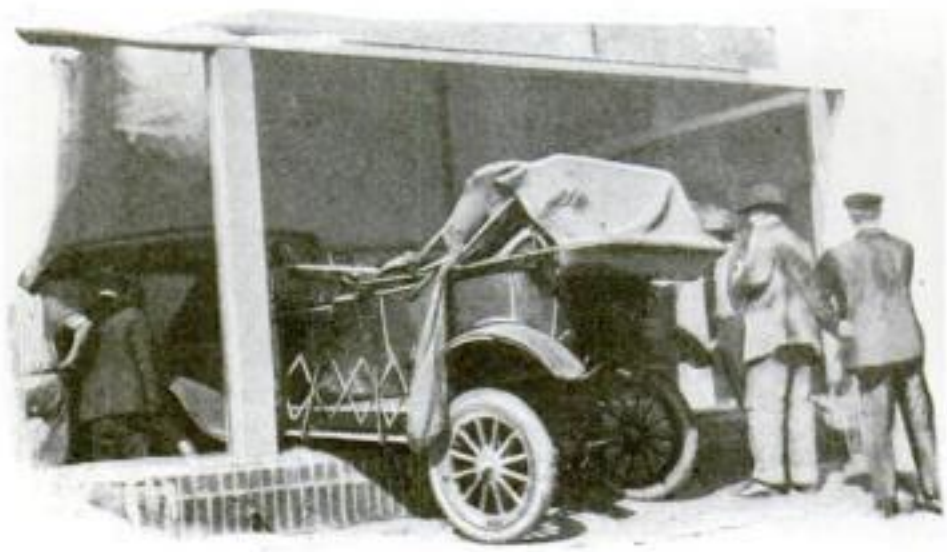
In one year she laid three hundred and twenty-six eggs, completely breaking all previous records. That's why she was named Babe Ruth. According to statistics compiled by her owner, her feed for the year cost four dollars and the eggs she produced were worth sixteen. Thus she brought her owner a profit of twelve dollars.

The Automobile with a Soul

A HORSE will often neigh with joy when it sees one of its kind; but an automobile is not credited with any such emotions. Yet here we have a car that started to roll down hill when its brakes were accidentally released; it was traveling at a terrific speed and it suddenly swung round, leaped the curb, hurdled a two-foot show-window wall, and came to an abrupt stop directly alongside of another automobile.

Was it mere chance that led this runaway car to a garage? Or did it have plain automobile sense and realize that garage meant home?

The make of this remarkable automobile is not apparent; it is hardly to be guaranteed that the rest of its tribe would display the same amount of intelligence in similar emergencies.



Old Airplane Parts in a Caravan

IF you are one of the lucky mortals who can "go South" in the winter-time, why not get a light, comfortable caravan like the one below and live in it? The caravan is built on an axle and two wheels that were meant for an airplane. Many of these extra wheels and axles were left over when peace was declared, and such a caravan as this offers one way of using them up.

The body of the caravan is made of wood and canvas. Windows and ventilating holes in the roof will prevent the interior from becoming stuffy. There are four struts, one at each corner, which are lowered to support the caravan after an automobile has towed it to its final resting-place.

A Japanese Hat Used for a Lamp-Shade

WE have been assured that "a rose by any other name would smell as sweet," and a lampshade by any other name would not only work as well, but would probably cost considerably less. For lampshades have never lost the charm of high price unless they were made at home.

Take, for example, a Japanese bamboo hat; it costs about fifty cents. Put it on top of a table-lamp and it will make a very acceptable shade. Yet where could you buy a lampshade for fify cents? If you care to, you might line it with pink or amber or any suitable shade of silk to give it color.

A Japanese hat has still another use: it might be put over an open dish to keep the contents warm or free from dust.

Pushing the Boat Along

TO push a boat from the back while riding in it is a feat accomplished by the novel device shown in the picture below. The oarsman works a set of paddles that are attached to the stern of the boat and connected with a hand lever inside the boat.

The working backward and forward of this lever manipulates the paddles and furnishes beneficial exercise for the back and arms of the oarsman.

With such a device there is no danger of having the oars mislaid or stolen, or of having them lost in the water. The paddles are hung on "hinges" which permit them to ply the water easily, and may be used both at a time or individually, as desired.

© Underwood & Underwood

Abraham Lincoln Wore These Big Boots

SONGS have been written about Lincoln's gunboats, but not about his own boots. Surely they are worthy of comment; they are quite the most uncomfortable-looking boots imaginable.

Leather was cheap in Lincoln's time, and the shoemakers were very generous with it. The boots they made reached to the wearer's knees. He had to wear them even on the hottest days. As for shape—there wasn't much. A single strip of leather stretched from the toe to the center of the boot and then continued on up to the top.

Lincoln's boots were size fourteen, yet his feet measured eleven and a half inches. Thus two and a half inches of space was wasted, while his big toe had no place to go.

In this day of scientifically made shoes it is difficult to understand the endurance of our forefathers that permitted them to smile in such discomfort.

Buying a Quarter's Worth of Electricity

YOU will find that this little attachment to an electric meter will allow you to purchase a quarter's worth of current at a time. Quarter gas-meters have been in use for a number of years, but this is the first attempt to develop an electric meter to operate on this principle.

The quarter is inserted in the slot and the knob turned in a left-hand direction. The meter will then allow twenty-five cents' worth of current to pass. When this amount of current is used up, the lights go out and another coin must be inserted.

This meter has been designed for use especially in summer resorts, where there is a floating population. Electric-light companies have always had great trouble collecting bills from such localities.

To Jail by Airplane

AERIAL policemen in San Francisco are thus far the first to make use of the airplane to conduct a prisoner to jail, *via* the automobile patrol.

The sky route offers the most direct passage between two places, and in this instance the prisoner was transferred from the Alexandra county jail across the bay of San Francisco to the locality where an automobile patrol was waiting to continue the journey through the city. Where it is necessary to save time, the airplane can be of service, as in this case.

When the air becomes crowded with machines, the arrest of violators of the air-traffic laws will undoubtedly become common and aerial patrols will no longer excite comment.

© Kadel & Herbert

© Kadel & Herbert

There Is More than One Way to Smuggle Jewels

But it takes a clever man to succeed

An expert smuggler would know better than to roll his jewels into an elaborate cane-top: inspectors have long been suspicious of canes. Yet occasionally an amateur smuggler will try to swagger in with one

A good cigar is sometimes a smoke and sometimes a jewel-box. Here you see a cigar which, when broken, revealed a large diamond. The owner tried to smuggle it into the country, but the inspector got it first

The smuggler really has a difficult time thinking up harmless-looking hiding-places for his rubies and pearls. One man put them in his fountain-pen, another—a man wearing a peaked hat and a badge in his buttonhole—took them out

Jewels and toothpaste—who would associate the two? "No one," said the confident smuggler to himself. But he was wrong; the inspector ripped open the tube and squeezed out half a dozen smeary pearls

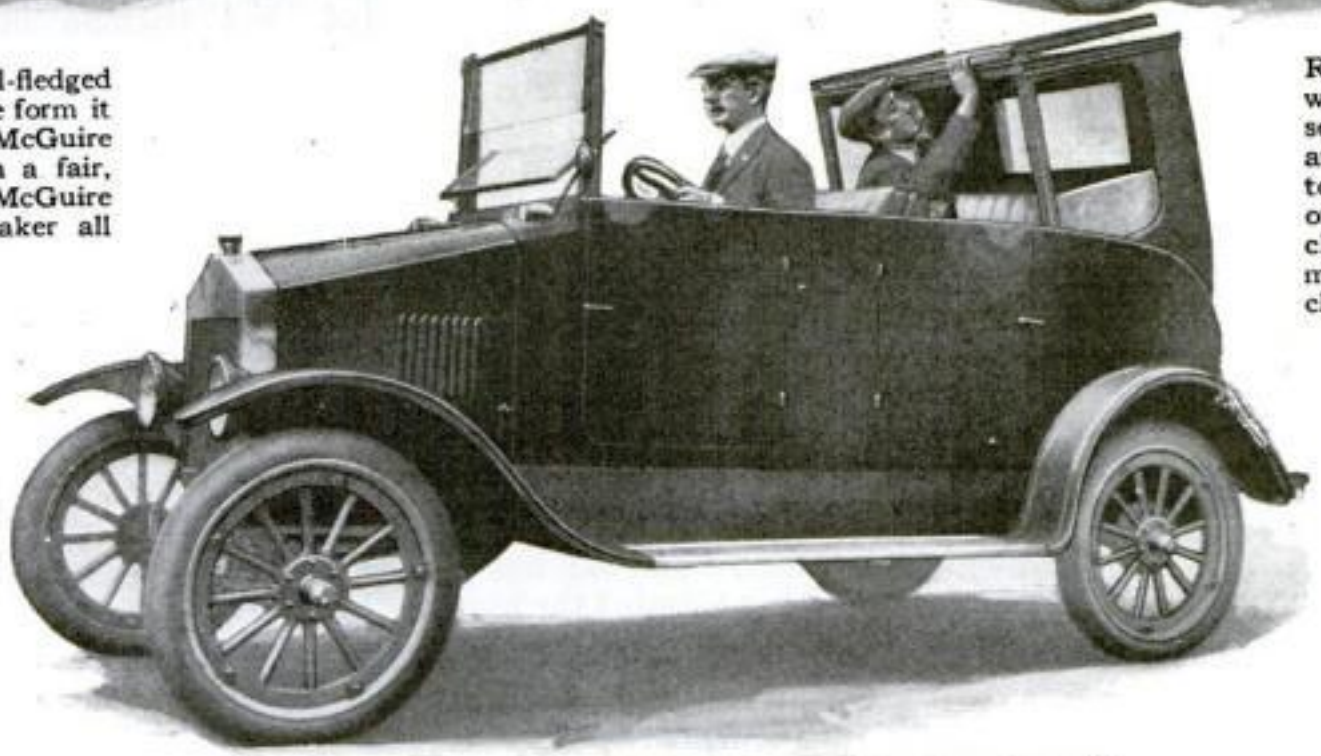
This camera may be perfectly innocent, but the inspector looks it over very thoroughly. It has so many hidden corners

This rubber heel may have saved the wearer's nerves a thousand shocks in the past, but it's making up for it now. Imagine his feelings as the inspector pries it loose and takes out the pearls resting snugly within it

Change the Body to Suit Your Taste

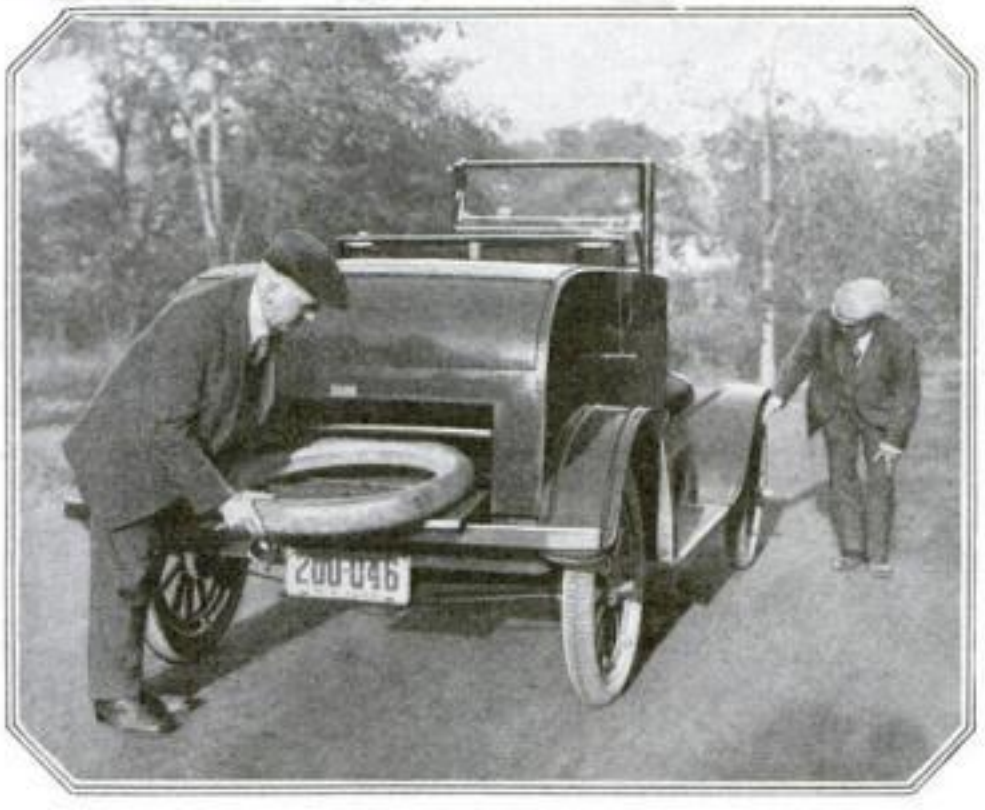
No more family arguments over which style of car to buy

The car is here a full-fledged roadster. This is the form it takes when Mr. McGuire rides to his office on a fair, warm morning. Mr. McGuire has been a coach-maker all his life



Remove the front window-panes of the sedan, fold up the top, and you have an open touring-car with a sort of victoria top. This changeable body is mounted on a "flivver" chassis

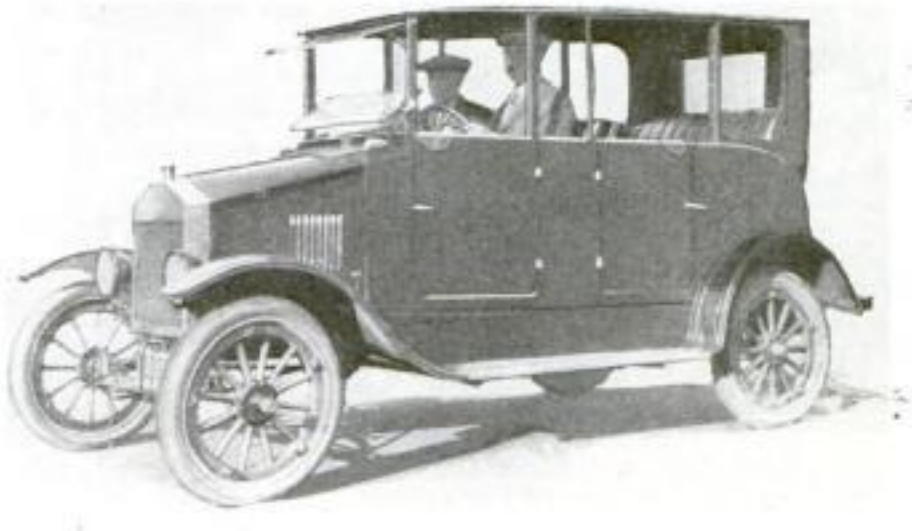
To the right is shown the special compartment for spare tires beneath the rear seat. The backs of the front seats are on hinges and can be lowered to meet the rear ones, thus forming a bed



"When a touring-car becomes a roadster" is a suitable title for the picture at top center. The top is swung forward until its edge rests on the back of the front seat. The rear cushions automatically disappear below when this happens

A coupé for two is illustrated below. It is made by resurrecting the back and side windows and bringing them forward to the windshield. These windows cannot be opened from the outside, so when the door is locked, no thief can enter

Below: What is it? A sedan of course. But the inventor, Mr. John J. McGuire of New York, has constructed it so that it can be transformed into practically any other type of car as the mood of the owner dictates



The End of the World

Our sun may some day be a "new star" for the universe

By Latimer J. Wilson

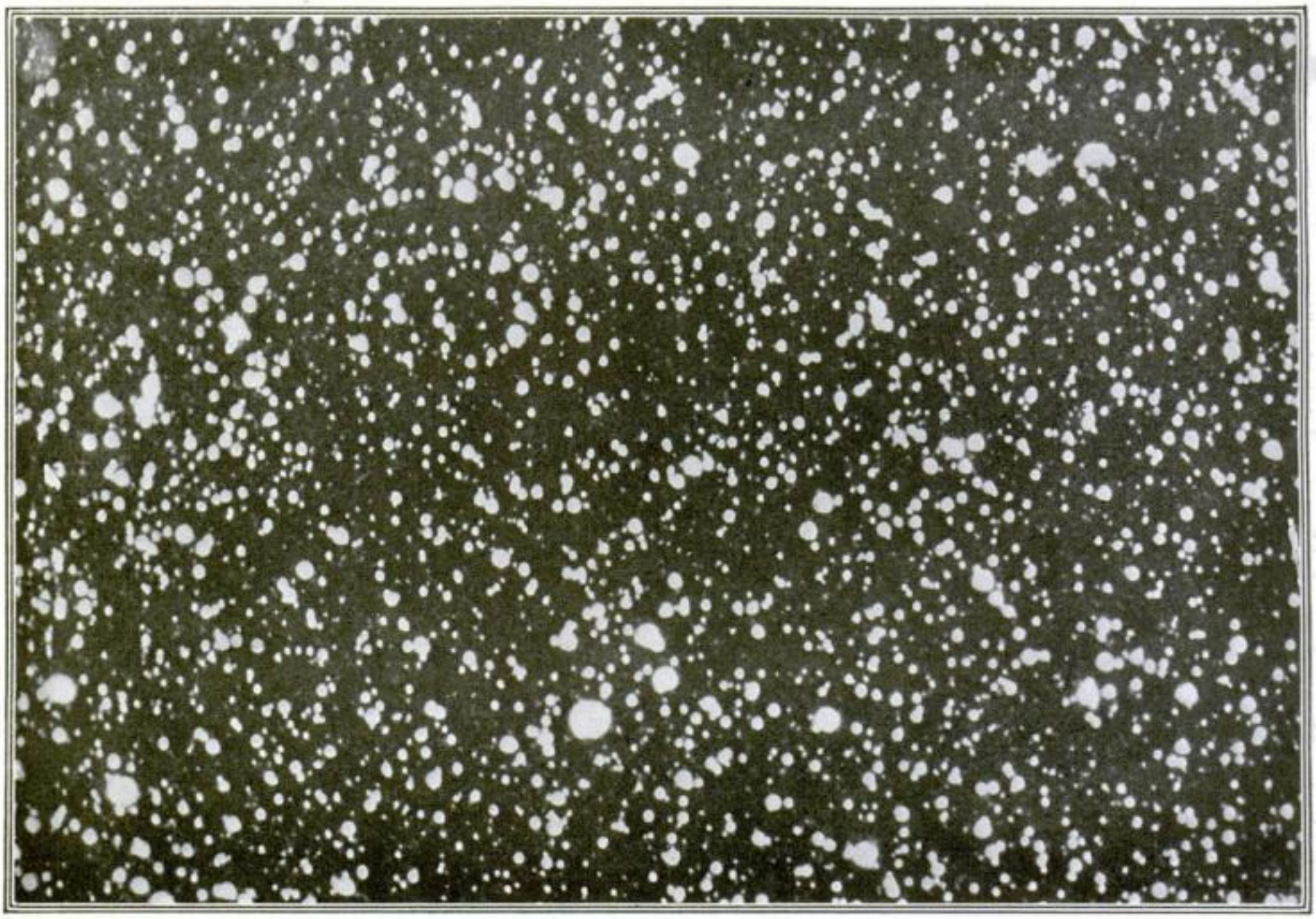
A BLAZE of light flashes in the sky where perhaps no star was seen before, and a "new star" is heralded throughout the world. What does it mean? According to the generally accepted opinion of astronomers, nothing else than the end of a distant solar system, a cataclysm that has, at least temporarily, terminated the existence of a sun and its planets. Recent discovery has strongly confirmed this opinion.

All astronomical eyes are directed toward a new star when it appears, and the remarkable changes in its light and color are observed. Photographs are taken, and its spectrum, or color-band, is closely studied. Perhaps the star will have become so bright that it rivals all other stars and can be seen in full daylight. Gradually it begins to fade, usually changing from white to yellow, then to red, finally fading into a greenish nebula. This is the order usually followed in all the stars that are designated new, or temporary, stars.

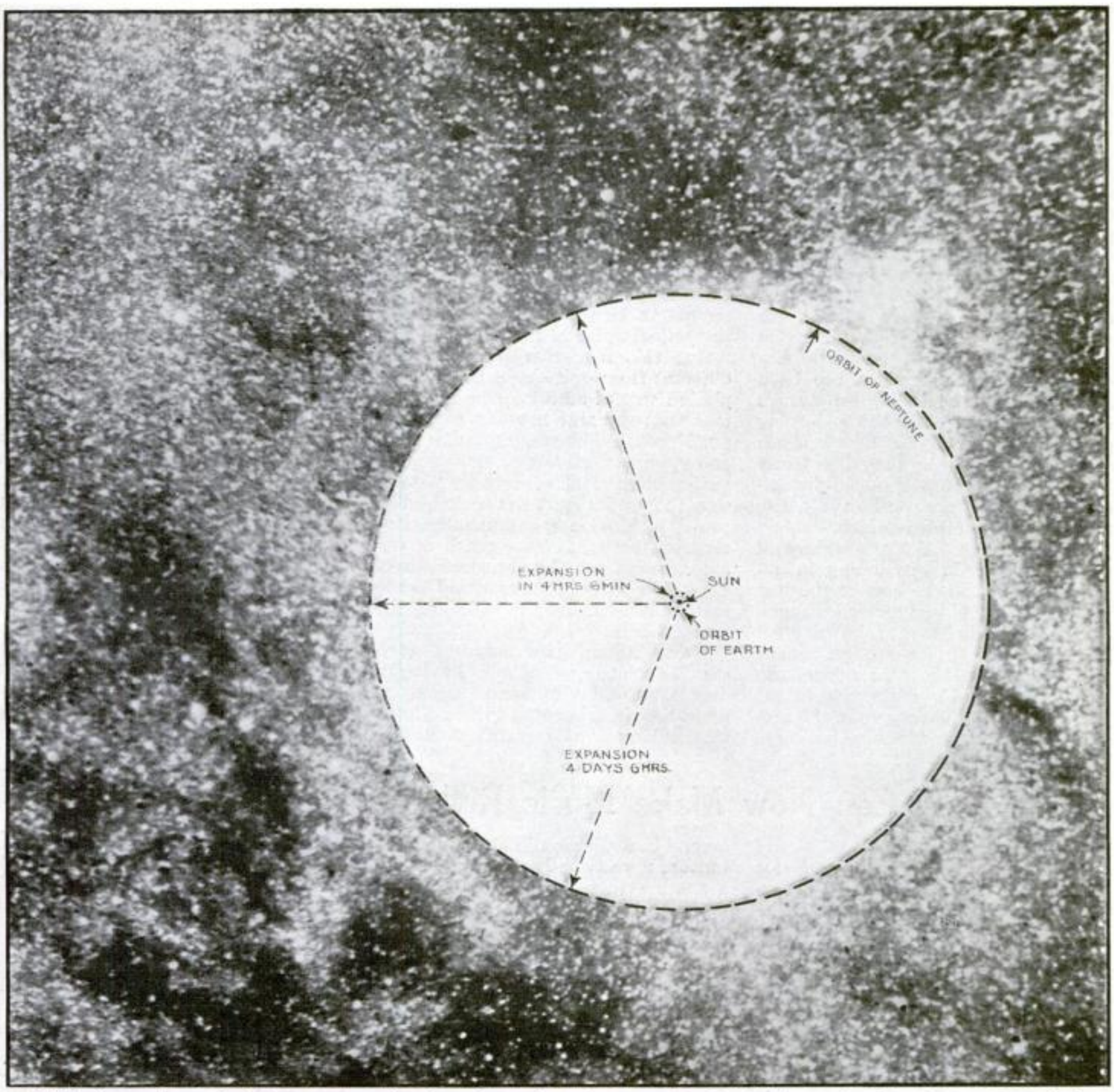
Long before the invention of telescopes the occasional flash of a "nova" attracted the eyes of people. Out of the darkness of night the brilliant new star seemed to flame, burning brightly for a few days and then sinking back into the depths of the unknown. What was a puzzle to the ancients, arousing only curiosity and superstition, has become a separate branch of scientific research, and to-day the problem of the new stars is seemingly within the reach of our understanding.

Nothing in history is more amazing than the explanation that the most exact of sciences offers to account for the temporary stars. One of the most conspicuous "novae" of recent times was that which appeared suddenly in the constellation Perseus in 1901. It was a splendid object as seen with the naked eye. In June, 1918, another nova blazed out in the constellation Aquila. In each instance the star was actually seen to turn into a mass of luminous gas, a nebula; but the nova in Aquila has afforded the most astonishing confirmation of the theory of such stars. On the eighth of June, the night following the eclipse of the sun, this magnificent star was discovered by every one who looked skyward. For several nights it was the brightest star in the sky at that time, and in brightness second only to the brightest of all stars, Sirius. With the blue-white Vega and the pure white Altair, the nova of Aquila formed a gigantic celestial triangle in the summer sky. Photographs showed it on plates taken several nights before the date of its greatest brilliancy. In the interval it had increased in luminosity many thousand times. Prior to this it had registered on photographic plates as an exceedingly faint star in the region of the Milky Way.

What is the meaning of these outbursts in the distant realm of the universe, and what import have they in the lives of men? To understand the meaning, one must understand the curious changes in their light as disclosed by the spectroscope. The spectrum of a bright body is its light



Seen from a distance the sun would appear utterly lost among the stars of the Milky Way. This pictures a section of the spangled stream of the galaxy. The sun would be much closer to be thus seen than are any of the stars shown here



This indicates the speed of the masses traveling from the sun if it should imitate the new star in Aquila. The expansion of the materials of the outburst, following the terrific and instantaneous rush of light and heat, would be at the rate of eight thousand miles a second. If a cloud were shot from the sun at a speed of eight thousand miles a second, it would reach the earth in four hours, and would fill the whole of the solar system within less than five days

spread out into a ribbon of color. If the body consists of a luminous heated solid, or a gas under great pressure, the form of this spectrum is a continuous color-ribbon, the color appearing in vertical bands and lines. A single element, such as sodium, when heated to incandescence, gives a single color, a double band of yellow. But hydrogen shows in the green, the blue, and the red sections of the spectrum. The electric arc produces a continuous band full of rainbow colors. The sun also gives the complete rainbow-tinted ribbon, but this band of color is crossed by curious combinations of *dark* lines. This was a puzzle until it was discovered that a luminous body, when surrounded by gases of the same substances in a lesser degree of incandescence, suffers a partial absorption of light, thus causing the formation of dark gaps, or lines across the continuous spectrum. The sun is surrounded by these cooler gases, and they stop some of the light sensations, thus producing dark spaces.

These dark lines, by their position and grouping, show exactly what substances are involved in the incandescence of the sun and stars. When a bright body is surrounded by a blazing atmosphere of incandescent gas, bright instead of dark lines appear, and these also have the same arrangement in the spectrum as have the dark lines of the same substances. In the region of sunspots are both bright and dark lines. Some of the gases around or above the spots are at a higher state of incandescence than the gases within the sunspots. The displacement of these lines toward the violet or the red end of the spectrum indicates, among other things, motion in the line of sight. The principle is illustrated by a similar phenomenon of sound in which the sound-waves are crowded and shortened and rise in pitch as the object emitting them approaches us. Thus a locomotive whistle rises to a shrill shriek as the train dashes in our direction, while it falls in pitch as the train recedes. So the light sensations are quickened with the approach of their source, or lengthened in proportion as their

source recedes from our line of sight.

This furnishes the key to interpreting the curious conduct of new stars. At first the color-ribbon is crossed by strong dark lines all shifted toward the violet or short-wave end of the spectrum. This shows that the gases surrounding the star are violently in motion toward us. Then, as the nova flares brighter, strange bright lines appear. But they are wide and diffused, their centers agreeing with their proper place in the spectrum. Measure the width of these lines, and you find that they are extended both toward the violet and toward the red end of the spectrum, indicating that the luminous gases producing them are both approaching and receding—a strange anomaly! How can these blazing gases in the far distant star be both coming and going at the same time? The answer is one of the most ingenious pieces of reasoning in the whole field of astronomical research.

It assumes that the atmosphere of the new star is expanding in all directions around the core of the star in a bright shell of incandescent vapors. Hydrogen and helium are the principal gases involved. The motion in our line of sight on the near side of the incandescent shell shifts the bright lines toward the violet, while the motion around this area is directed more and more away from us, causing a shifting of the lines toward the red. The rate shows that the expanding gases reach a velocity of nearly eight thousand miles a second. It is difficult to conceive of matter moving at such a speed.

Then the question arose, might it not be possible to detect this expansion of the star in the increased size of its volume as seen through the telescope? Ordinarily there is no star, except the sun, that shows a measurable disk. The face of distant suns is indeed too remote to be seen except as a mere theoretical point of light.

But this new star proved to be different from ordinary suns. Its explosion was of such an enormous extent that the star actually expanded until it reached a measurable diameter, and since the cataclysm first became visible it has continued to increase in size, though its light has waned, until to-day it shines only as a nebulous star that is just beyond the reach of unaided visibility. The measured rate of expansion proved to correspond to the rate indicated by the shift of the spectral lines.

Nova Aquila now appears as a starlike planetary nebula having a disk 3.8 seconds of arc in diameter, appearing in telescopes to be as large as the largest of Jupiter's moons as seen with the same glass. But in actual size it dwarfs into insignificance the vast space occupied by our sun and planets. The period usually required in stars of this sort to return to their pre-nova degree of brightness ranges from eight to fifteen years. This is exceedingly short when one considers the magnitude of the outburst.

Calculations show that the outburst of this star occurred nine hundred years ago. Light traveling 186,000 miles a second has been all that time reaching us from the region of the cataclysm which regenerated a faint sun into a new nebula.

If imagination be permitted to run in the fantastic direction indicated by disasters of such gigantic scale as that witnessed in Nova Aquila, might we not imagine a similar catastrophe befalling our sun in some remote future day? Perhaps the center of our solar system will suffer a similar convulsion. Something will let loose the pent-up energy of the star, rending asunder the bonds of gravity and releasing the compressed gases. In a moment the burst of incandescence would wither the earth and planets. In the distance across the ocean of space, astronomers on some other world would see a "nova" in their sky, and it is not pleasant to think that we should be furnishing the spectacle.

Anybody Can Now Make Music Rolls

YOU don't have to be an expert pianist to make music rolls for player-pianos. Any one who understands time and rests can, by using the machine pictured, make his own rolls.

There is a note scale, on which treble and bass notes are recorded. This scale extends the full width of the machine. Beneath it the music-roll paper is stretched. Perforations are punched by a pointer that travels back and forth across the note scale. When you have located the note you wish to register, you move the pointer to it.

The time scale is at the left of the machine. After the operator has adjusted the pointer on the note scale, he moves the note scale to the proper place on the time scale. Then, by pressing lightly on a punch button, he makes a perforation in the paper. If the note is to be held for several beats, he continues tapping the button, moving the note scale forward a notch at a time. This is repeated until all the notes in that particular section of paper have been recorded. Then the paper is released and moved forward and work started on a new section.

You repeat this action until the whole roll is perforated.

With a note scale on one side and a time scale on the other, any one can make piano-player music rolls with this new machine.

Present-Day Surgeons Must Be Good Carpenters

WE have wondered at the skill of surgeons in grafting pieces of skin from a frog's leg or from a human body upon the skinless injury caused by a burn or other accident.

But the marvels of modern surgery do not end there. "Bone" grafting is an art that demands the skill of a specialist in the most remarkable kind of "carpentry."

Electrically driven circular saws in the hands of a bone carpenter can now be used to slot, splice, and alter a fractured part of one's skeleton. Sometimes a part of the broken bone is neatly shaped and slid down into a slot cut into a part of the fractured member. Screws of steel, silver, ivory, or screws made out of the patient's own skeleton, are used to hold these jointed pieces firmly in place.

One curious result of these ingenious attempts is that of repairing an injured jaw. A piece of bone removed from the edge of a broken hip-bone was found to serve splendidly when properly fitted into a man's broken jaw. This man to-day literally chews his food with his hip-bone—an anomalous situation indeed!

Never before in the world's history was there such an opportunity for bone carpentry as that offered by the war. The knowledge thus gained was not lost with the coming of peace

Sacrificing a Battleship to the Science of War

The old "Iowa" is first to be made the subject of wireless-control experiments and then shot to pieces

THE most famous veteran in the United States Navy, the pre-dreadnought type battleship *Iowa*, now coast battleship Number 4, is slated for some experiments in wireless control, and then to be shot to pieces by the guns of the fleet.

At Santiago, under the command of "Fighting Bob" Evans, the *Iowa* played a conspicuous part, giving the mortal blows to the *Cristobal Colon* with her forward pair of twelve-inch guns. In the great war she served as a training-ship.

The *Iowa's* guns and other valuable equipment are being removed and the coal-burning boilers are being replaced by two oil-burning ones, which facilitate control. The weight thus saved will probably be used in modern deck armor.

The wireless equipment will consist of about the same apparatus as that used by John Hays Hammond in his wirelessly controlled boat a few years ago. This system was used by the Germans in their attack on the British monitors that bombarded their positions on the Belgian coast. Mr. Hammond is superintending the instalment of the wireless equipment.

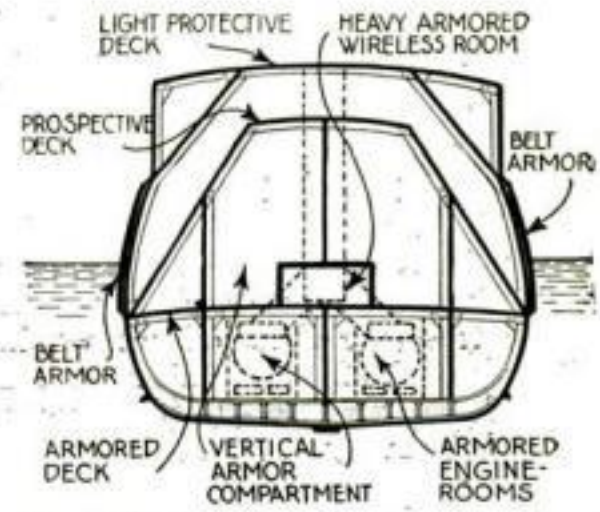
When all changes have been made, the *Iowa* will steam down the Chesapeake for some very thorough trials with her wireless control. It is desired that the ship shall be controlled alternately from another ship, a shore station, and an airplane or seaplane.

After the wireless tests have been completed, the *Iowa* will proceed to the battleship range and proving-grounds farther down the bay, where her crew will leave her. Control will then be taken over by a seaplane. The firing tests will be made as near to war conditions as possible. The *Iowa* will proceed under her own power, when a squadron of destroyers will dash past her, enveloping her in a dense smoke-screen. The battleship force will arrive on the scene and will begin firing. With a blurred vision at great ranges, it will be almost impossible for the shells to hit their target except for the airplanes, which will spot the fire of the big guns. As each shell falls, its exact location in relation to the target will be radioed back to the pointers from one of the seaplanes.

While wireless control of ships dates from 1896, it is still in its infancy and must be developed for safety's sake. It is therefore reported that the battleship *Ohio* will be fitted out for this purpose later.

Still another ship, the former German dreadnought *Ostfriesland*, may be used as a target for the big guns. This German ship has a most complete system of internal protection and will therefore supply the needed example of deck protection.

"Fighting Bob" Evans' famous old *Iowa*, which the Navy Department is preparing for very thorough experiments in wireless control



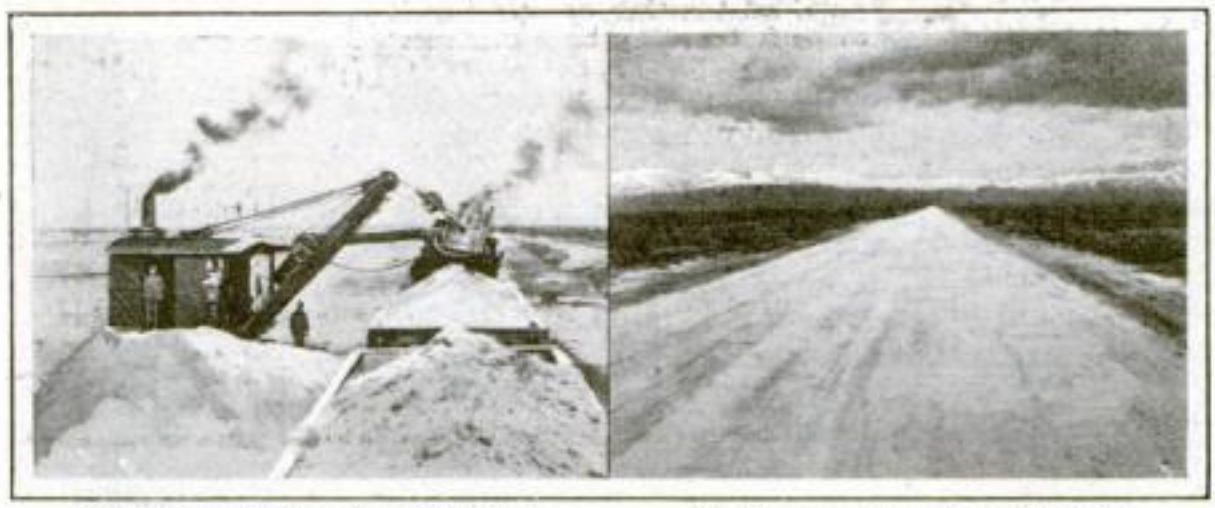
How the *Iowa* is being refitted. The wireless equipment is about the same as that used by the Germans in their attack on the British monitors off Belgium

How a Road Was Built from Salt

MOST road-building materials are expensive. The people of Utah had millions of tons of good road material in their state, and did not know it.

The Great Salt Lake washes upon its shores tremendous quantities of decayed salt. This substance was formerly considered a nuisance until a progressive contractor discovered its value as a road-building material. When properly treated it was found to have better wearing qualities than most.

After the tests, it was at once decided to build a link of the Lincoln Highway with it. A small railroad was run into the heavy deposits and a steam shovel loaded the cars that carried the material.



The steam-shovel is loading on railroad-cars decayed salt from the Great Salt Lake; the picture opposite shows how it was used

Waste salt was discovered by chemical tests to possess excellent qualities for road-making purposes

New Uses for the Photographer's Tripod

It often happens that a photographer is also an artist. In an emergency the artist-photographer can use his tripod to advantage as an easel

The tripod also comes in handy in the sick-room. If a tray is fitted with a nut corresponding to the tripod screw, a tray may be firmly fixed so that the dishes are safe

If a tripod is firm, it will serve as a typewriter stand. A base is put on the typewriter into which a nut corresponding to the tripod screw is fixed

Steel Structures that Have No Rivets

WHEN a New York company engaged in electric welding operations decided to erect a new building, its engineers suggested that the structural parts of the steel framework be joined autogenously by welding instead of by bolts or rivets. They were confident that this method would save time and money.

As there was no precedent, the municipal authorities, when asked for a building permit, refused to issue it unless tests were made that would satisfy the building officials that a welded structure would be as strong and safe in every respect as a riveted structure.

Lap welds of various structural units were submitted to severe tests, the results of which were entirely satisfactory to the officials. They issued a permit for the erection of the steel framework, but insisted on a special test of the steel trusses of forty-feet span, which were to support the roof and the traveling crane of five-ton capacity.

Two truss units of the fan type and with a span of forty feet were set up, supported at their ends only. They were placed parallel twenty feet apart and connected by steel cross-bars. The test load, consisting of gravel in bags, was piled in tiers on planking placed on top of the steel structure.

The trusses were designed for a live load of forty pounds to each square foot, each truss supporting a panel of eight hundred square feet. They were tested with a load of one hundred and twenty pounds to the square foot, or a total load of forty-eight tons on the two trusses.

Steel framework of a building can be welded together as safely as it can be fastened by bolts or rivets

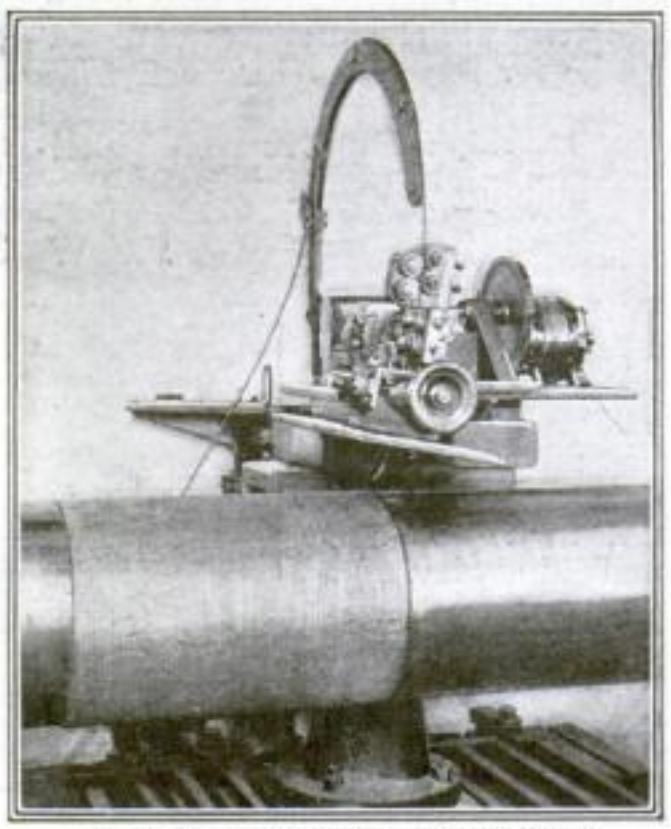
Representatives of all building departments in Greater New York attended the test, which gave the most satisfactory results. The deflections caused by the load were carefully measured, and when the entire load was removed two days later, it was found that, with exception of one single point, all parts of the trusses had returned to their original position.

Welding a Shaft with an Arc and a Steel Wire

THE new automatic arc welder will weld away for hours without attention. It will mend broken seams, plates, joints, and fractures.

It is shown welding a steel wire to a shaft that was turned below size by mistake. The shaft is turned slowly and the wire welded to its surface.

The wire is fed slowly by a small electric motor. It also passes through a simple straightener before it reaches the arc at the surface of the steel shaft. When the welding is done, the shaft will be turned over again to the correct size.



A new electric arc welder that does its work quietly and efficiently

Saving $7000 a Day with a Snow-Removing Machine

By **Joseph Brinker**

NICKNAMED the "snow-tank," because it looks somewhat like a combination of giant farming harvester, war tank, and tractor, this huge vehicle picks up snow and ice at the front and unloads it at the rear into wagons or trucks running alongside in the same direction.

According to its inventor, Samuel Friedman, of New York city, it can load as much snow as eight hand shovelers in one twentieth the time.

The foundation of the machine is a four-wheel-driven motor-truck that can be run at a speed of from two to ten miles an hour, and that, according to its inventor, can load 1300 eight-cubic-yard motor-trucks daily if operated continuously and that number of trucks are loaded one apiece or a smaller number loaded more than once in rotation. When this is done, Dr. Friedman claims that the machine will save $7000 daily as compared with hand shoveling.

How the Snow Is Loaded

The snow is picked up by means of two longitudinally inclined belt-conveyors, which carry it up to a boxlike compartment at the rear, where a second crosswise slat-conveyor automatically discharges the snow through a side door into the body of a motor-truck running alongside the machine at the same speed and in the same direction. Thus the entire snow pick-up and unloading is done mechanically. The longitudinal pick-up conveyors run continuously while the tank is in motion, but the crosswise conveyor is working only when the load is being discharged.

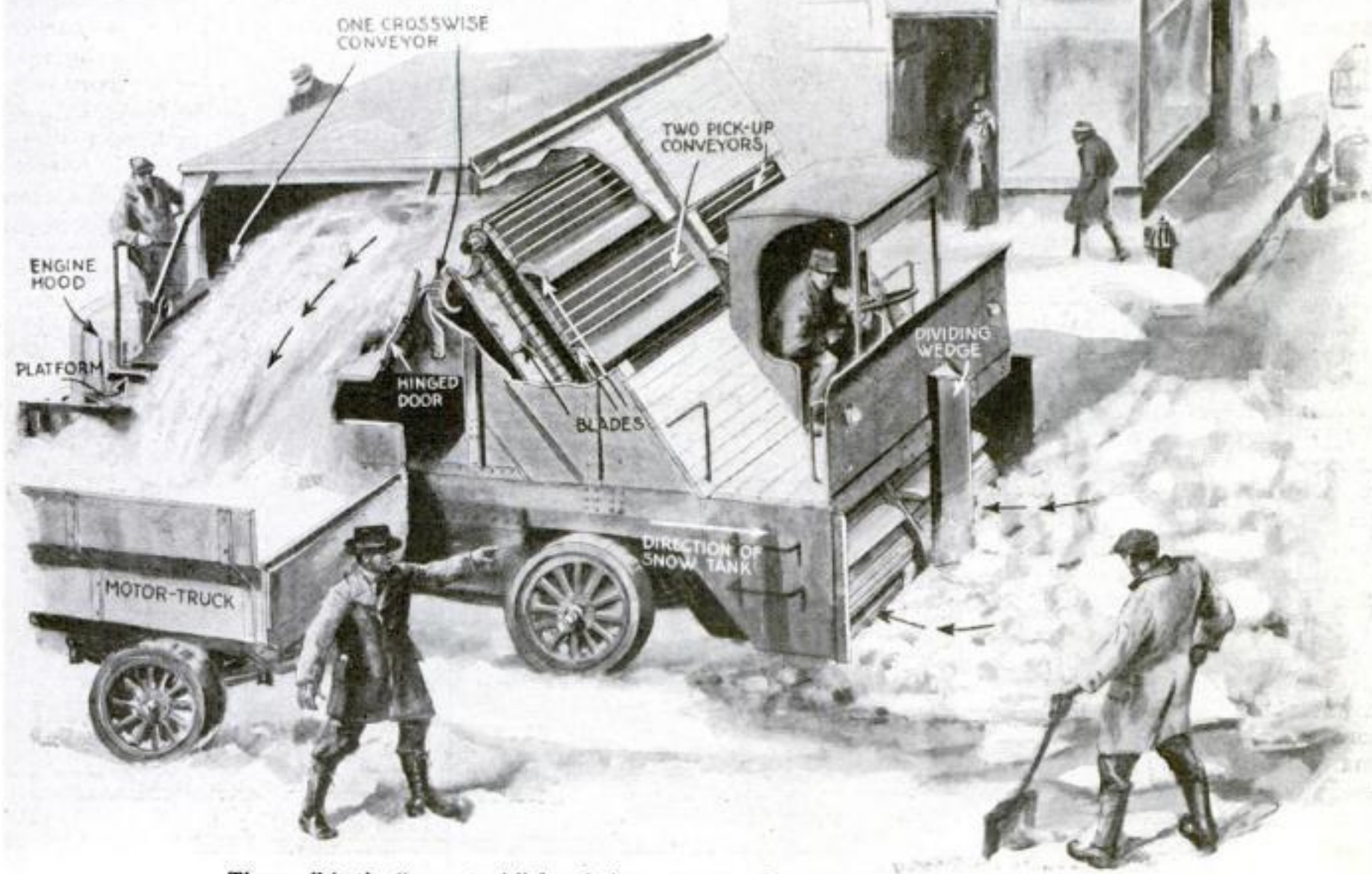
The entire mechanism is operated by a 150-horsepower marine gasoline engine mounted at the rear of the chassis frame. Only one power plant is necessary, since special clutches are provided for vehicle propulsion, for the longitudinal conveyors and transverse conveyor. All three may be operated at once, or any one or combination as required. The longitudinally inclined conveyors at the front extend to within a few inches of the ground and are provided with heavy bladelike shovels on endless belts. These blades cut into the snow or ice and carry it up the belts as the apparatus moves forward. At the top or rear of the longitudinal conveyors, the snow is deposited into a hopper or boxlike receptacle, the floor of which consists of the transverse conveyor. The latter moves in either direction.

As soon as one truck is loaded, it pulls away and another truck takes its place. In case the snow is not to be loaded into vehicles but it is desired only to clean a path ten feet wide down the center of the street, one of the hopper side doors is left open and the transverse conveyor run continuously and the snow is also discharged continuously to one side or the other.

Doubling the Removal Capacity

One especial advantage of the machine lies in the fact that it compresses the snow in loading, rather than expands it, as is the case with hand shoveling. Due to the action of the longitudinal pick-up conveyor blades in raising the snow from the ground to the hopper, it is claimed that sixteen yards of snow on the ground are compressed to eight yards in the hopper. On the other hand, six cubic yards on the ground expand to eight yards with hand shoveling.

Three men are required to operate the tank, the driver at the front in his own cab to steer and work the propelling clutch, and two other men, who stand on a platform at the rear of the hopper, one to control the longitudinal pick-up conveyors and the other to manipulate the crosswise loading conveyor.



They call it the "snow-tank" for obvious reasons. It scoops up snow and ice and deposits it in a steady flow into a motor-truck running alongside at the same rate of speed

This Submarine Gathers Sponges

Long pincers reach out from the boat and bring them in

By Jacques Boyer

HITHERTO submarines have been invented and constructed for purposes of destruction. Their record in the great war, as every one knows, proved them an extremely dangerous weapon. But the submarine shown below, an invention of M. Raoul, a French abbé, is intended to be used for gathering sponges from the bottom of the ocean. It was built by a manufacturing company at Toulon, France, where it was thoroughly tested by submerging it to a depth of some three hundred feet in the harbor. It stood the test perfectly and returned to the surface without showing the slightest defect.

The *Raoul-Rimbaud*, as the craft is named, has a length of about fifteen feet, and in salt water displaces about 8¾ tons. It carries two persons. It consists of a steel cylinder with a diameter of approximately five feet, and has a rounded cap at each end. The submarine is entered through a manhole in the top, surmounted by a small tower.

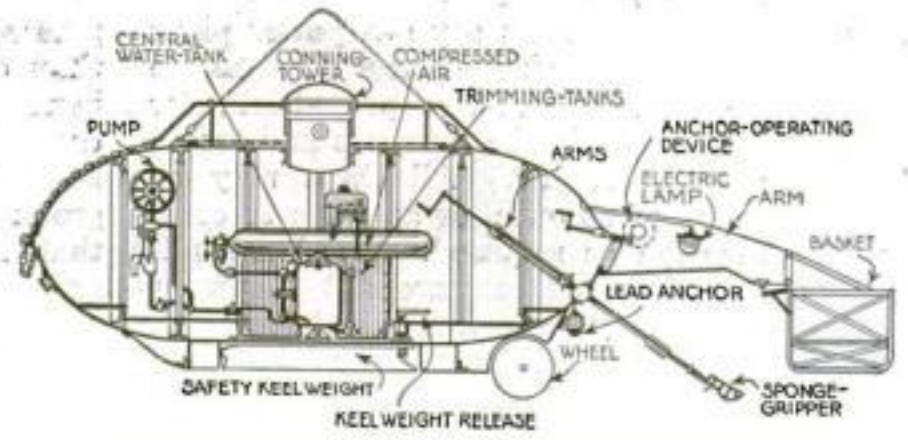
This opening can be hermetically closed by means of a cap, which may be operated either from the inside or from the outside, in case of an accident to the submerging and emerging mechanism. A simple turn of the handle of the closing mechanism is all that is necessary to lock or unlock the cover of the manhole.

Construction of This Submarine

In its interior the submarine craft contains two reservoirs capable of holding air at a pressure of about 230 pounds to the square inch, and three water bulkheads that serve for submerging and raising the craft. Two of these bulkheads hold 250 quarts each, and serve to overcome the greater part of the craft's buoyancy. They are filled directly by the sea and are emptied by hand pumps.

The third tank, which is located in the center, holds only about sixty quarts. It receives its water through a tube connecting it with the sea, and is emptied by the compressed air contained in the pressure tanks before mentioned. Under normal conditions the craft is submerged by filling this third tank with water and is raised to the surface by forcing the water out of it by compressed air. For greater security, a lead keel, weighing about fifteen hundred pounds, is attached to the bottom of the craft, and may be released from the interior in case of danger, to bring the craft quickly to the surface. In front of the craft a sounding-lead weighing fifty pounds is suspended, which may be lowered or raised by a hand windlass on the inside to produce slight vertical changes of position.

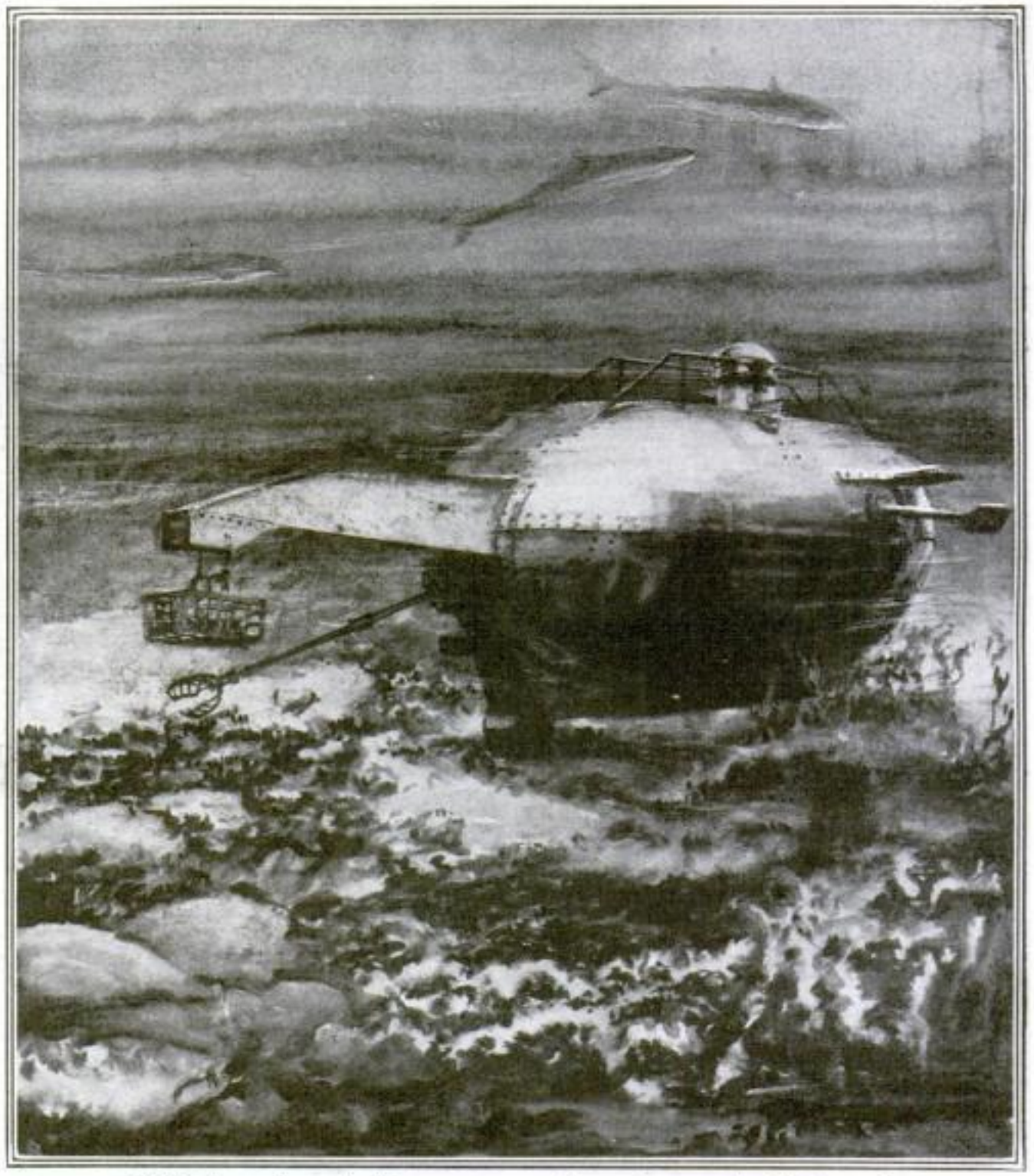
The submarine is propelled by two oars of steel, which are connected with the interior by a ball joint similar to that of the torpedo-tubes. The steel rod of each oar has at its free end hinged wings which are so arranged that they push against the water in a direction opposite that of the intended motion of the craft, and fold up when they are moved in the direction of the boat's course.



Space is limited in this craft and this cross-section shows how compactly its interior equipment is arranged

How Sponges Are Gathered

In front of the keel is placed a broad wheel of moderate diameter, which, after the submergence of the craft,



Gathering a harvest of sponges grown by nature on the bottom of the sea, is the peaceful mission of this man-built monster

rests on the bottom of the sea and makes it possible to move the craft with the aid of the oars, without resorting to the tedious operation of lifting the hull by expelling part of the water in the ballast bulkheads every time a change of position is desired.

The apparatus for gathering the sponges consists merely of a pair of concave cutting pincers at the end of a telescoping steel rod which is operated from the inside of the craft and extends several feet beyond the bow. The craft has a beaklike extension of steel plates in front, which serves a double purpose. It carries a group of incandescent lamps operated by electricity from a storage battery, and supports also a large basket into which the sponges gathered are deposited. The sponge-gatherer in the bow carefully inspects the bottom of the sea within the radius of his lights. If he espies a sponge, he grasps it with the pincers at the end of the gathering-rod, tears or cuts it from its base, and deposits it in the basket.

The interior of the craft is illuminated by electric lights supplied by the storage battery already mentioned, and the crew may communicate by telephone with the consort ship.

Although the craft carries a crew of only two men, the supply of air quickly becomes exhausted. The installation of an air-purifying plant or of oxygen tanks is not feasible. The submarine must be raised from time to time and ventilated to prevent the men from suffocating.

Comparison with the figure of the man in the background gives a good idea of the size and proportions of the submarine craft

Maintaining the Water-Level of a Great Canal

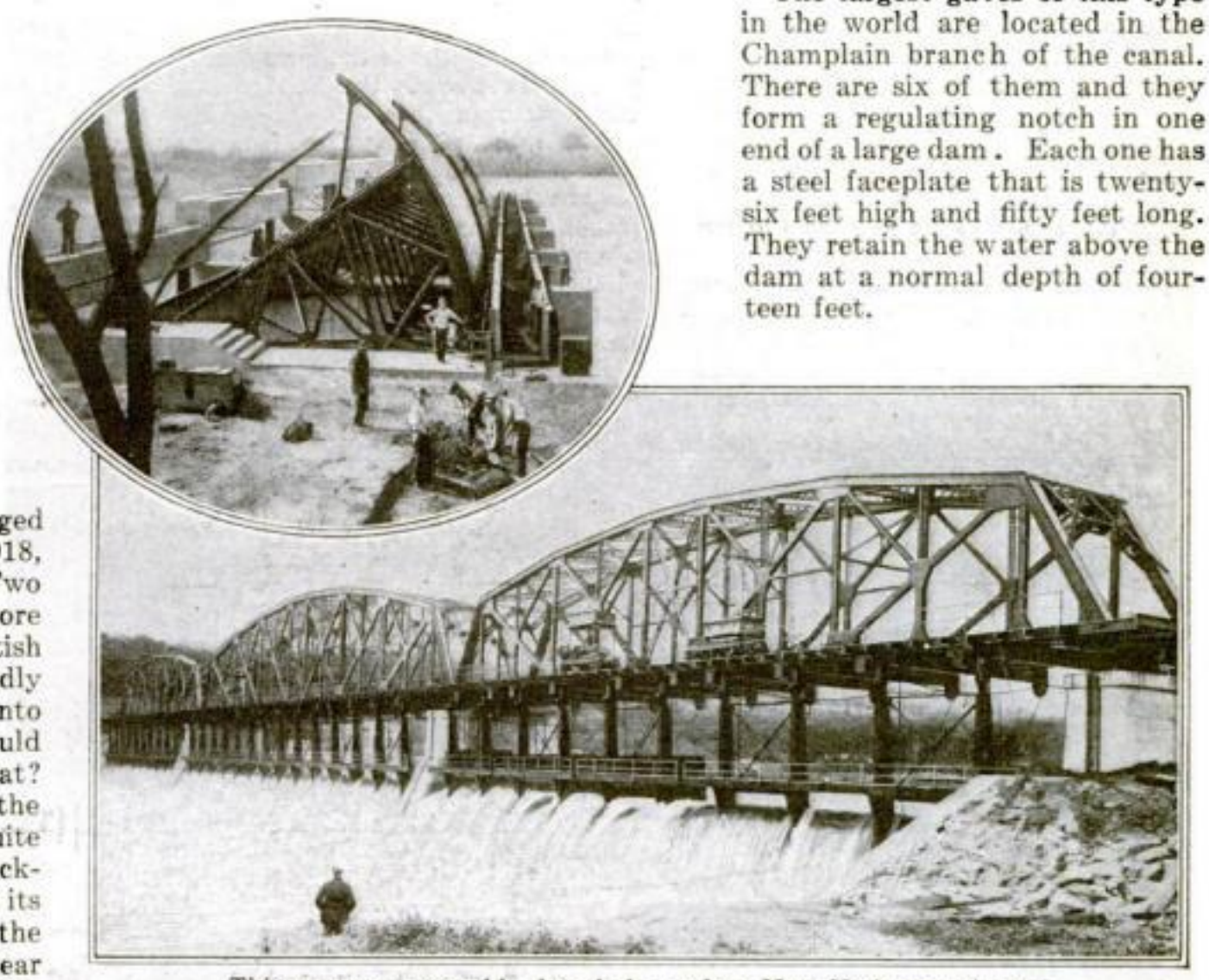
IN building the New York state barge canal much damming was necessary. Between Schenectady and Rome on the Erie branch there are eight huge dams of the so-called bridge type. They look like steel truss bridges except that there are no approaches.

The first step in making one of these dams is to build a concrete sill across the bed of the river. On the down-stream side of these sills steel frames are built and they are connected with a bridgelike superstructure by hinges. In the spaces between the frames there are sliding steel gates which may be raised or lowered to control the flow of water through the dam. The gates are moved by chains wound and unwound by electric winches in the bridge floor.

During the navigation season the gates are down, but in the event of a flood they are raised to permit the escape of water. During the winter months the gates and the frames—they rest on the sill but are not attached to it—are raised to a horizontal position, thus leaving an unobstructed channel through which ice and snow may flow.

There are also dams of the fixed type which have movable sections for regulating the depth of the water. These sections are semicircular in shape; they are called sector gates. They are of steel and are counterbalanced by concrete blocks. Each gate rests on a wooden sill and is hand operated.

The largest gates of this type in the world are located in the Champlain branch of the canal. There are six of them and they form a regulating notch in one end of a large dam. Each one has a steel faceplate that is twenty-six feet high and fifty feet long. They retain the water above the dam at a normal depth of fourteen feet.



This enormous movable dam is located on New York state barge canal. Steel frames are hinged to the bridgelike superstructure, and they rest on a concrete sill. Above are shown the huge circular steel plates that are used as movable sections in an adjustable dam

Two Years in the Life of a Salmon

A CHINOOK salmon was tagged by mistake on August 13, 1918, at Whidbey Island, Washington. Two years later it was caught in a shore trap in the Skeena river, British Columbia. You will undoubtedly remember that Prohibition went into effect between those dates. Could the fish have been influenced by that?

At the time of the tagging the chinook salmon must have been quite young, for it was mistaken for a sockeye salmon. Thus at the time of its recapture it had not reached the spawning age. Then why was it near shore instead of out to sea? The Bureau of Fisheries is very much interested in the wanderings of this fish.

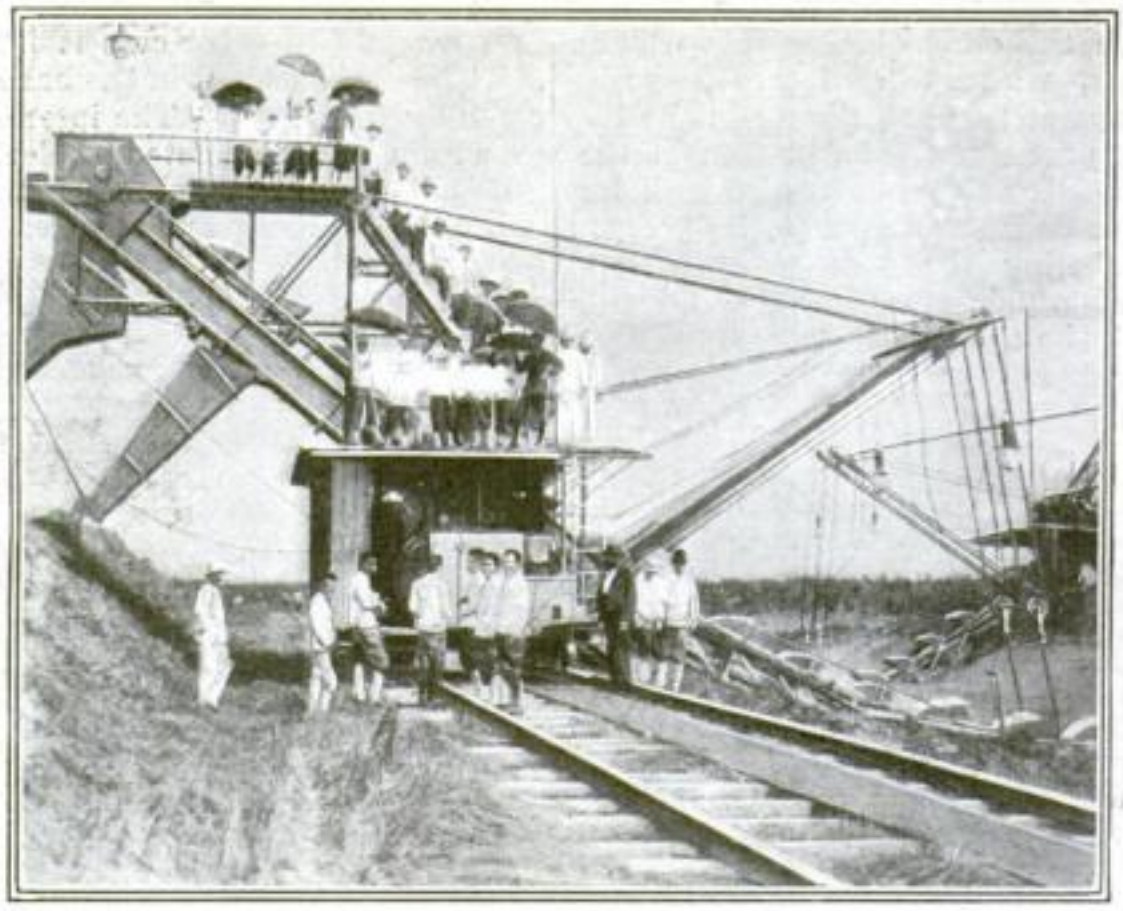
A Pencil-Holder Made from a Piston

IF you want to make use of the discarded piston of an automobile engine, here is one way to do it.

On the desk it serves as a paperweight, a pencil-holder, and a cigarette-holder, all in one. The small hole in the side of the piston, which was used to pin the piston-rod to the head, is just the right size to accommodate one's cigarette, though there is no place for the ash.

Not only does this expedient serve as a pencil-holder; it can also be made to do service as a flower-pot.

"To what base uses we may return," is probably the sentiment of the piston; but at least it is a use.



Siam Adopts the Dry Dredger

REMARKABLE progress in the construction of roads in Siam is evidenced by the photograph reproduced above.

The big dry dredger is thoroughly modern and up to date. The endless chain of scoops digs up the loose ground or soil at railroad cuts. These scoops or buckets carry the material gathered in by them to the screens, where it is separated into sand and gravel which slide down in shoots by their own gravity and are deposited in separate piles.

The motive power is supplied by a gasoline motor. The bucket chain can be extended to a distance of about one hundred and twenty feet.

One of these large dredgers will remove and separate about two hundred and fifty cubic yards an hour.

A depth of forty-five feet may be reached by the dredger and the material may be deposited to an equal height. The machine attracted a great deal of attention when it was set up at its destination. The picture shows the appearance of the machine during the ceremonies of its dedication in the presence of the Siamese king and other dignitaries, who evidently attached much importance to the event.

Colored Lights for Window Display

WINDOW-DRESSERS who wish to introduce theatrical lighting effects can easily do so with the gelatine slide that fits across the reflector holding an electric bulb.

The device consists of a metal frame that fits over the rim of the reflector. The gelatine slide is supported in this frame by a netting of fine steel mesh. The color of the gelatine will not fade by exposure to the electric light. The colored screens can be automatically changed, throwing red, blue, violet, green, purple, and yellow light upon the display. Artificial moonlight as well as golden sunlight can be imitated, giving a richness to the setting of the windows.

Men Who Repair Skeletons

THERE are two kinds of skeleton-menders—the bone surgeon and the skeleton-assembler. Art schools, medical colleges, and students of anatomy require an accurately constructed skeleton to aid in their work.

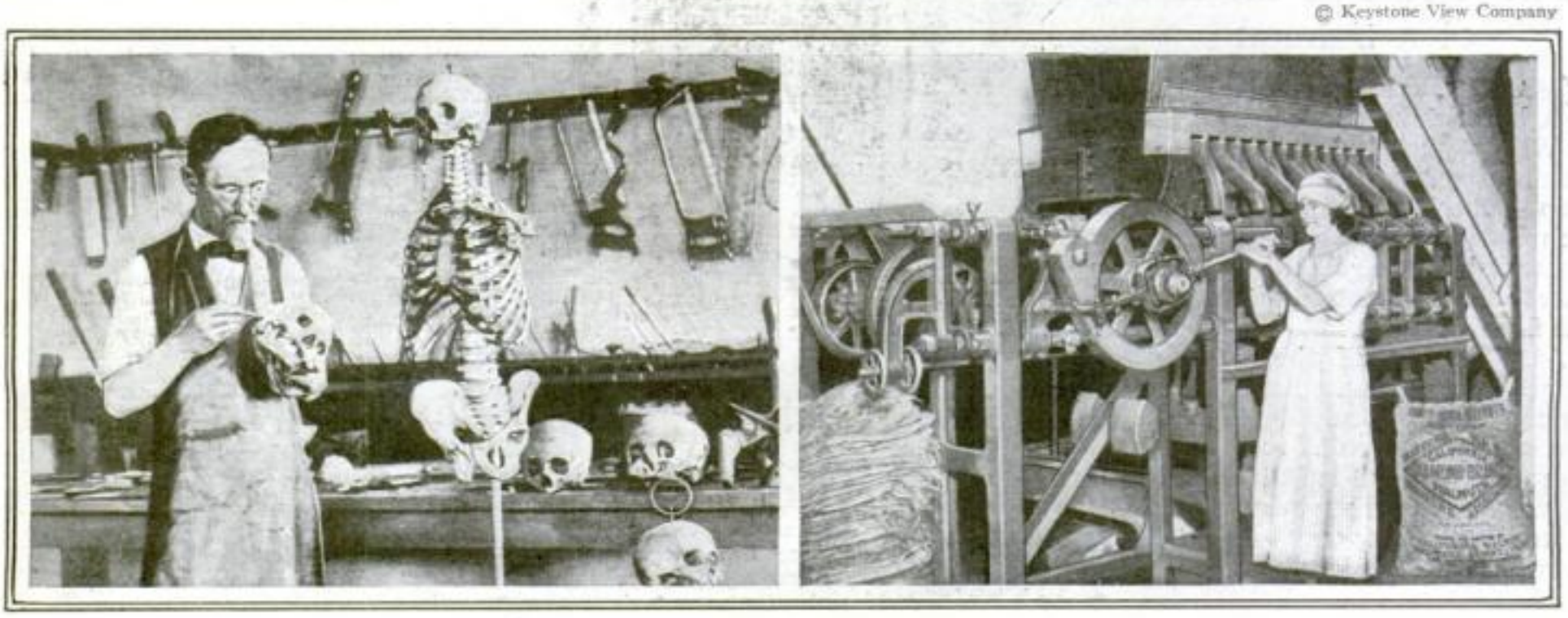
All the bones must be properly assorted and carefully put together. They are strung on fine wires. The skeleton-assembler must also pick out of the hundreds of odd bones that are sent him the two hundred and more bones that belong to the particular individual being reconstructed. It is not an easy task, and the price of skeletons is justified by the amount of work required to construct them.

A Giant Mechanical Nutcracker

CRACKING walnuts is the job of this mechanical giant with its two "hands" having fourteen fingers on each. These metallic hands constitute two units, each of which can be used separately.

The walnuts are dumped into a hopper at the top of the machine and are admitted to the pairs of open metallic fingers through metal channels. There are seven channels on each side.

The open crackers are so arranged that the largest nuts can be held and yet the smallest will not drop through. With a complete revolution of the device twenty-four nuts are cracked without crushing the meats.



Typewriter Lamp Made from Speedometer Shaft

THE flexible covering which encloses the shaft of your speedometer becomes a valuable aid when you want to make a lamp for the typewriter. If there is not a discarded shaft-casing out in the garage, it is an easy matter to get one from the repairman.

The typewriter lamp shown in the illustration was made from an old hall "tree" used formerly as a hat- and coat-rack. Its arms or branches had been removed and the speedometer-shaft casing was soldered to the top of the tree. The electricity-bearing cable passes into the flexible metal casing, where it joins the top of the tree. The light can be easily adjusted.

A speedometer shaft attached to any upright support mounted solidly can be adapted to making a table-lamp.

Two-Piece Railroad Ties

RAILROAD ties of special design have been developed to facilitate the erection of small-gage railroads on large construction jobs. The secret of the method lies in the new tie, which is made of cast iron.

Each tie is made in two parts and these lock together in the manner illustrated when the rails are laid. One end of each half is bent slightly upward so that it will brace the rails. The tiepieces also interlock when they are placed in the proper position. The rail is held securely against the bent ends of the ties by small iron clamps that are bolted in place on the outside. Means are also provided to drive stakes into the ground to hold the rails in place.

Rails laid in this manner may be taken up or changed in a very short time and with practically no expense but the labor.

How We Look from Above

PHOTOGRAPHS taken from the air by aerial travelers show the ugly spots on the beautiful landscape made by man's artificialities. Houses resemble confetti scattered on a green rug; fields look like a crazy-patch quilt. Roads and paths are puzzles for Sherlock Holmes to solve.

Contrasted with these views, however, are many truly beautiful estates whose design ornaments the general landscape in a pleasing fashion.

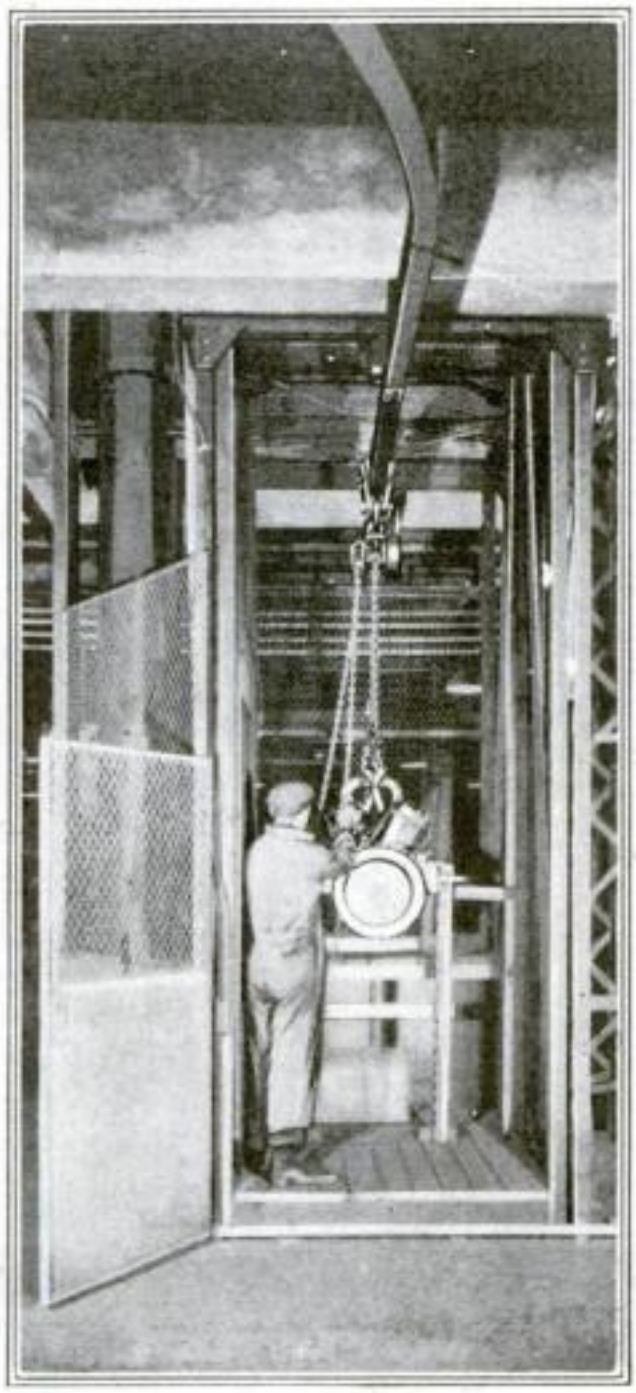
The new angle of view affords opportunities for the future landscape architect. Cities of the future can be planned from the air; indeed, this method is already being used in planning the suburbs of some of our large cities.

Coasting a Motor from Third Floor to Basement

SOME automobile factories assemble their motors on an upper floor, and then have them conveyed to the first floor or basement to be tested in the dynamometer.

A quick way to get the motor downstairs is to "coast" it down on a conveyor controlled by an air-operated device.

The conveyor is started in motion by a single movement of the master air-valve. An automatic tripper causes the carriage to stop at a designated point, where the monorail on the carriage engages with the main rail on the ceiling of the dynamometer room. From this position the load can be shifted to any point in the room.



How They Save Coal in England with a Flower-Pot

A FLOWER-POT will cut your coal-bill in half! That seems rather strange, doesn't it? Yet many fellow sufferers from the shortage of coal in England have put flower-pots in their stoves and grates and are using half as much coal as they used formerly.

Before you build your fire, place an inverted flower-pot in the center of the grate. If your stove is small, use a small pot; if large, a large one. Then lay your wood and coal around it. When your fire is going strong, you will find that your stove gives out just as much heat as it did when there was no flower-pot within.

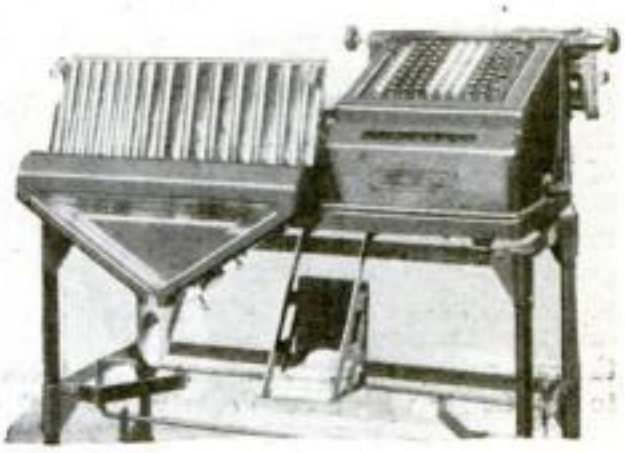
Should it happen that flower-pots are not much in evidence in your neighborhood, a brick will serve the same purpose.

Pay-Envelopes Filled by Machine

IN using the new pay-roll machine, the cashier first lists all of the salary amounts. When the last amount is listed, there is available, automatically added by the machine, not only the total amount of the pay-roll, but the exact number of each denomination of coin required for the pay-roll.

After the schedule is prepared, the device is replaced by a coin-tray in which have been placed all coins, gold, silver, and copper. To the left of the coin-tray is a keyboard.

As the amount for each envelope is called out, the operator presses the proper keys and pulls a lever. The machine automatically counts out the proper number of each kind of coin and drops them into the envelope. At the same time the machine makes a printed record of the amount.



© Kadel & Herbert

Fooling the Rabbit-Hounds

SEVERAL dogs chasing one small rabbit—that was too much for the humane societies of Oakland, California. They protested against the inhumanities of coursing, and the result was the mechanical rabbit shown above.

It is made of steel and wire, covered with a real rabbit's skin. It is attached to the end of a long metal arm and is driven by a five-horsepower motor. The rabbit can make a speed of forty-five miles an hour, and completely fools the eager dogs that pursue it.

Bees Eaten for Revenge

BEES are usually employed as manufacturers of honey, which is everywhere considered a delicious food, but there are places where the bees themselves serve as a food.

The negroes of Guiana, when stung by a bee, proceed to catch as many as they can and in revenge eat them. It would be interesting to know what happens as an effect of the stings thus taken internally.

In Ceylon the natives hold a torch under the bee swarm hanging to a tree, catch them as they drop, then carry them home, boil them, and eat them.

A Daffodil Will Make a Novel Candlestick

NOW that electricity has been installed in most city houses and has done away with lighting inconveniences, people are clamoring for candles! Gloomy candlelight when given off by artistic candles is preferred to the efficient glow of electric light.

Here you see an artistic candle in an even more artistic holder. Should you fail to recognize it, let us announce that it is supposed to look like a daffodil. The flower itself holds the candle, and three of the leaves make the stand.

The entire flower is made of metal and is painted yellow and green. Were it not for the sharp unnatural bends in the leaves you might mistake the candlestick for the real thing. This is adaptable to any flower with a deep corolla.

The Queer-Looking Twins Are Baby Alligators

THE man who took this photograph was a patient fellow. He waited several years before the event happened. He was on the job, however, and snapped this picture when the youngsters were a few hours old.

Here they are, a couple of young alligators just out of their shells. They are not a bit rough, like their parents. In fact, they are so gentle and playful that children could have a good time playing with them.

True, like the snail, they cannot move very fast, but they get there. The one in the background has its mouth open. Probably its mama has already given it lessons in the wonderful art of fly-catching, since this is one of the delicacies in their diet.

Mail Your Letter on a Trolley-Car

"HELLO, what is your great hurry?" says one native of Hamburg, Germany, to another.

"I want to catch a mail-box," replies the other, dashing off down the street at great speed.

Mail-boxes are in the habit of standing still in the United States, and the above conversation would sound strange to us. In Hamburg and other European towns, however, the postal authorities have found it advisable to place mail-boxes on the back of the street-cars.

Food that Arabs Eat

ARABS catch locusts, roast them, pulverize them, and eat them as a pudding.

To prepare them for food, they dig a deep hole in the sand and build a fire in it. On top of this fire they throw bags of live locusts, cover them with sand, and build another fire on top. When they have roasted thus for a suitable time, the Arabs take out the locusts and grind them into a powder, which they mix with water and eat as a pudding. Locusts are pests in border regions of the Sahara, but when other food is scarce, they are welcome.

An Electric Decorative Table Fountain

CONCEALED in the base of this fountain a small electric motor keeps the water in circulation. No water connection is needed, and the fountain, with the charm it lends to its surroundings, can be added to any dining-table, sick-room, or living-room by merely inserting the plug in the electric-light socket.

The fountain is made of lacquered metal, cement, stone, or marble. It costs but a fraction of a cent an hour to operate, and there is absolutely no danger of its overflowing, since it contains only a few cupfuls of water.

If this small fountain becomes popular, larger ones will undoubtedly be made. Perhaps they will take the place of the tall flower-pot stands that went out of style a few years ago.

Antwerp's Old Torture Pump

IN the Steen, an old castle in Antwerp, said to have been built in the ninth century, is a pump that dates from the sixteenth century.

The water comes from a Roman well as old as the castle itself. It was from this well that water was drawn for the purpose of giving the "water cure," the "drop by drop," and other fiendish methods of torture employed upon the unfortunate prisoners confined in the dark dungeons under the building in the dreadful days of the dark ages.

Note the remarkable leverage by which the piston-rod of the pump is worked up and down. As a vacuum is created the pressure of the atmosphere forces the water upward.

A Huge Japanese Fan Blows Away the Chaff

MORE than sixty per cent of the population of Japan is engaged in the pursuit of agriculture, but there is room for improvement in their methods.

One of these is shown in the illustration. It consists of an old bellows fan which is worked to blow the chaff from the wheat.

More than one million acres in Japan are devoted to wheat-growing. Strangely enough, even with the unscientific implements that are used, the soil of Japan ranks higher in general production than that of Italy. What could be accomplished by the use of modern time-saving devices can be imagined.

The law requires that all suitable land not used for other purposes must be cultivated, and if any remains idle a certain time the state makes plain that its owner is violating the law.

The Concrete Garbage Furnace

DISPOSING of waste from the table and the kitchen is sometimes a problem that must be met by the individual instead of by the community. When one lives outside the city limits and has not the benefit of garbage collection, he must get rid of waste products as best he can and with as little delay as possible.

The use of an outside concrete furnace, inexpensive in construction, solves this problem satisfactorily. The quick fire made possible by the specially constructed flue burns the waste with the least effect of smoldering.

The fumes escape rapidly and are blown away, instead of remaining in the air, as they do when garbage is burned in a heap in the open.

Starting an Exciting Hoople Race on the Ice at Lake Placid

TWENTY years ago every city child had a hoople, and chased it for blocks and blocks with a stick. But to-day you see very few; the danger of running into automobiles is undoubtedly the reason.

The children of yesterday, however, are grown up today, and many of them still cling to their hooples. But instead of chasing them through the streets, they chase them across the ice on skates.

A hoople race is very exciting. The contestants are lined up at the starting position, and there is just enough space between them to make room for a hoople. If the hooples don't follow the straight and narrow path, they will collide and put their owners out of the race, sometimes spoiling the chances of several contestants.

© Edwin Levick

Fish-Nets for Active Babies

IF all people were as ambitious and persistent when they grow up as they were when they were babies, this would be a great world. Long before a baby's feet are strong enough to hold him, he tries to stand. Then, when he has finally learned how to stand and the newness of it wears off, he tries to climb. If he does manage to reach the top of his crib, he will undoubtedly fall out and hurt himself.

In an institution where many babies are brought up, this matter of climbing and falling assumes large proportions. Thus in one English babies' home all the cribs have fish-net covers. When the babies are awake the covers are fastened down.

The Stroke-Counter for Golfers

DO you play golf? Then you know how difficult it is to remember the exact number of strokes in which you made each of the eighteen holes of an exciting match.

The counter in the accompanying illustration enables the golfer who carries it to keep track of his record, hole by hole, with the least possible inconvenience. The counter resembles a watch with a dial on each flat side. Each large dial has nine small dials, resembling the second-dial of a watch, but divided into twenty divisions, one for each stroke. In making the record, the first of the small dials, directly under the stem, indicates the number of strokes for making the first hole. At each pressure of the knob of the stem the hand of the dial moves one degree. It is assumed that not more than twenty strokes are required to make any hole.

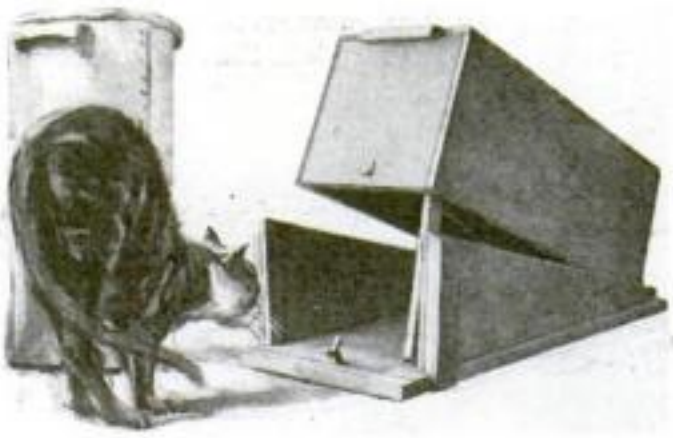
Trapping Vagrant Cats

RAT-TRAPS are common, but imagine a cat-trap!

Such a device, for ensnaring vagrant cats, has been designed and constructed by Ned Dearborn, of the United States Biological Survey.

The trap is so pivoted as to pull the prop under the edge of the box when the latter is raised. As the cat reaches for the bait, the treadle is tipped that springs the trap, the box falls, and a rod, coming in contact with the cat's back, releases an ounce of carbon bisulphid, which instantly and painlessly asphyxiates the animal.

The authorities proclaim the object of the trap "for catching vagrant cats and disposing of them humanely."



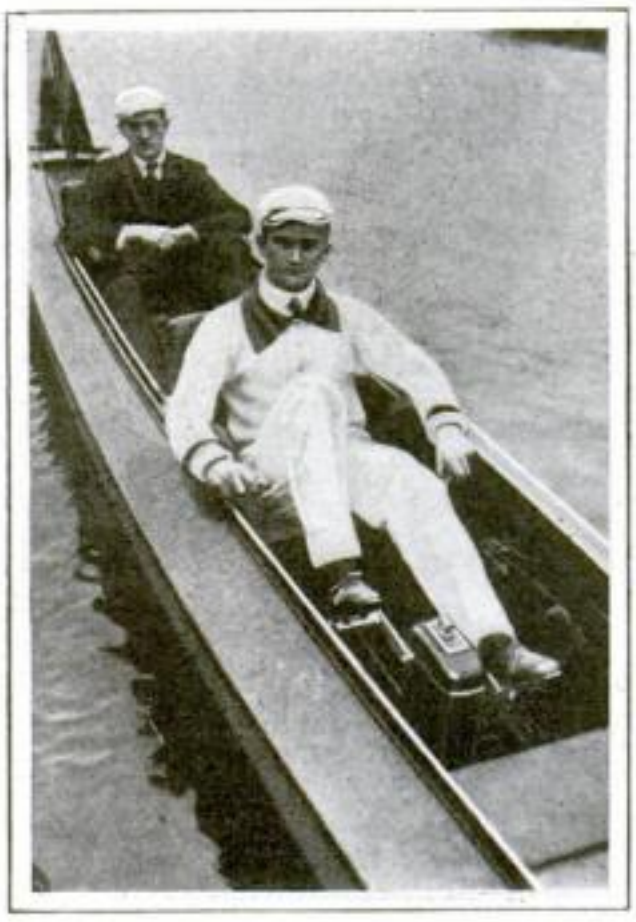
Rowing Twelve Miles an Hour with Your Feet

OUR legs are stronger than our arms. Why not use them instead of our arms whenever possible?

That is the idea that occurred to the man who designed and constructed the boat shown below. He drives it with a pedal arrangement similar to that on a bicycle.

A regular two-blade propeller is used, which gives a speed of from ten to twelve miles an hour if a "husky" is at the pedals.

Driving a boat in this way is very good exercise for everybody, and persons who like open-air sports will enjoy this one. The boat can also be driven in the usual way with a paddle or oars.



Use Old Automobile Cushions

CUSHIONS that helped make your car an easy-riding one in its day should not be junked when the car is given up as lost by automobile doctors. Keep them; if necessary, re-cover them, then place them in front of an open fireplace.

If you wish to toast marshmallows or roast popcorn, you will have an excellent seat. By resting your elbows on your knees you keep your arms from growing tired while the roasting or toasting goes on.

Any housewife could think of a dozen uses for old cushions, and for once the man of the house will agree that "that old junk" makes a welcome addition to a fireside seat in his smoking-room.

Planes that Went to Alaska

BUSINESS men of the future will probably own summer cottages in Alaska. The families will enjoy the delights of an arctic summer, and the husbands will take a "fly" up there to spend the week-end with them, making the trip from New York in the Alaska Flying Express!

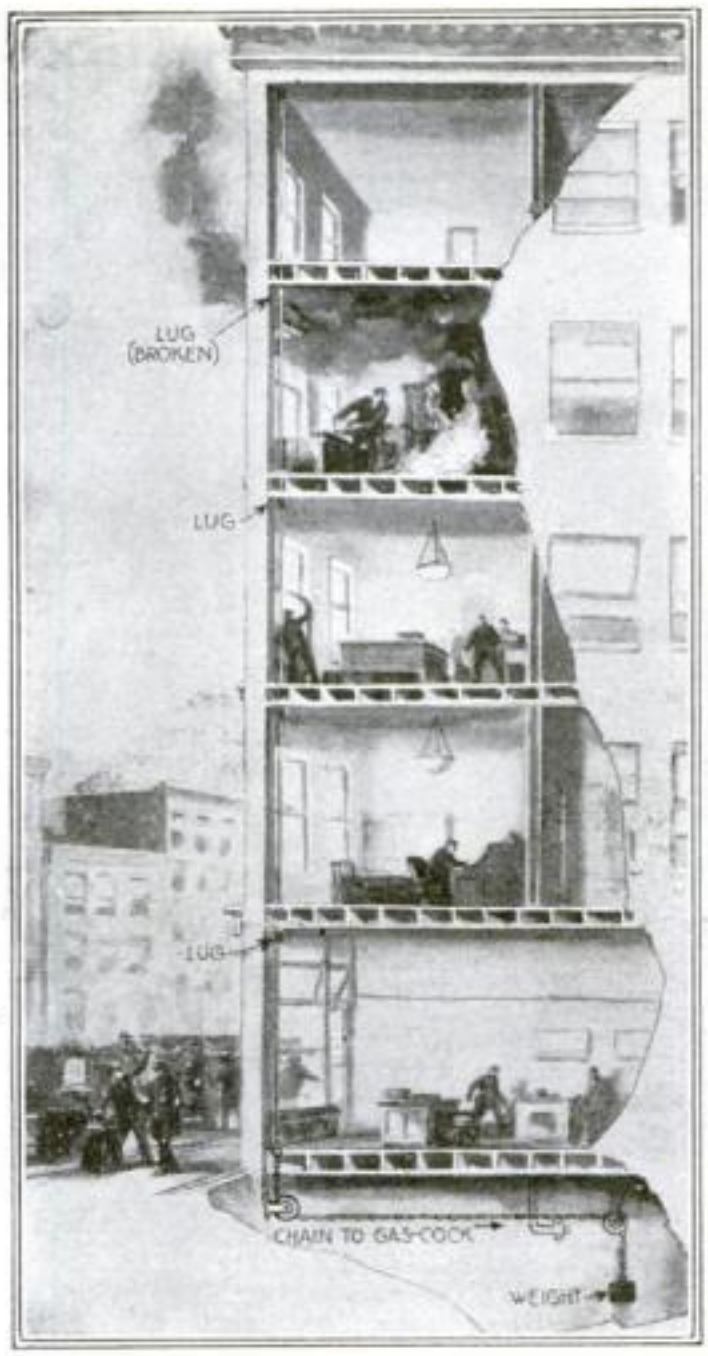
This is, of course, but a speculation of the future. That it is not an impractical undertaking has been demonstrated by the recent flight from New York city to Nome, Alaska, conducted by the United States Air Service in its memorable trail-blazing expedition.

The illustration shows the rudder of one of the three airplanes that made the flight. On it is painted the name of each stop included in the round trip and the pilot's and mechanic's names.

A Piano-Practice Keyboard

ON this new keyboard the keys have depressions in them. The inventor believes that these depressions will help piano students to develop better technique with less practice than is generally necessary to produce a good player. The depression in the center of the key trains the finger to strike the center of the key while playing.

By the continuous use of this keyboard, the student will train himself so thoroughly that his fingers will strike the center of the keys on a piano without conscious effort. This is one of the requisites of successful playing and it has always been very difficult to master.



How to Prevent Gas Explosions

IF city houses were equipped with an automatic device to cut off the gas as soon as fire reached the spot, probably many big fires would be prevented. Even a small fire that reaches the system of gas-pipes in a building can gain momentum by the burst of flame that follows.

There is a device arranged on each floor which automatically closes the flow of gas. Soft metal lugs on a connecting lug under the ceiling of each floor melt at 150° F. This disconnects the rod, releasing the handle cock in the cellar, which closes the gas immediately.

It would seem a wise law to make such a device compulsory in all large buildings.

© Keystone View Company

Spreading the Whipped Cream

THE modern chef has created a fine art in making cakes, and for these delicious products of his art the public is willing to pay high prices.

The chef in a prominent New York hotel uses a "bag" funnel in spreading whipped cream over a cake creation. This hotel takes good care of its employees in the culinary department, and if one of them receives as much as a slight scratch on the hand he is promptly attended by the doctor. Cleanliness as well as skill are the principal first considerations, and, wherever the process permits it, mechanical devices are used to prevent hands from coming in contact with food.

"Hustling" the Underground

LONDON'S "Underground" is a scene of rushing crowds and swift trains. The scramble to get aboard at the station platforms necessitates having a man whose duty it is to prevent a train from stopping longer than its fixed time at any station.

A special box is built for him; and, with his watch in one hand and the handle of a lever in the other, he keeps tab on the train stops. If a train remains longer than thirty seconds, he pulls the lever and this sounds a siren that warns the train crew that they must be off.

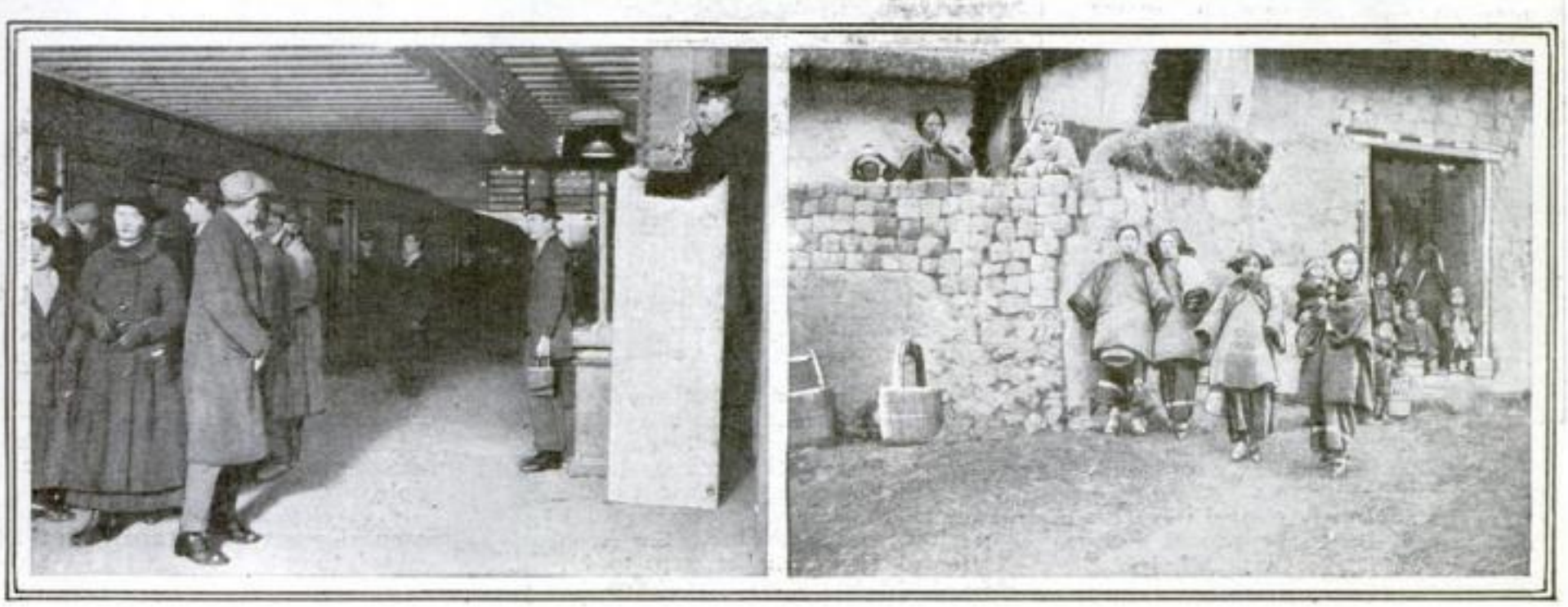
In the New York subway a gong is sounded for the same purpose. With the hurry and crowding always to be found in subways, the gong is the less nerve-racking signal.

Comfort Before Style in China

CHINESE women have not yet learned to ask for fur coats in winter-time. In fact, they wear practically the same clothes in winter as in summer. In the most severe weather, however, they wear heating baskets under their cloaks.

These baskets are plain wicker ones, such as we use for trash. Inside the baskets charcoal warmers are placed. They will radiate heat for hours. The charcoal is mixed with chemicals that generate oxygen, and thus the charcoal will burn constantly even though it is sealed in the containers.

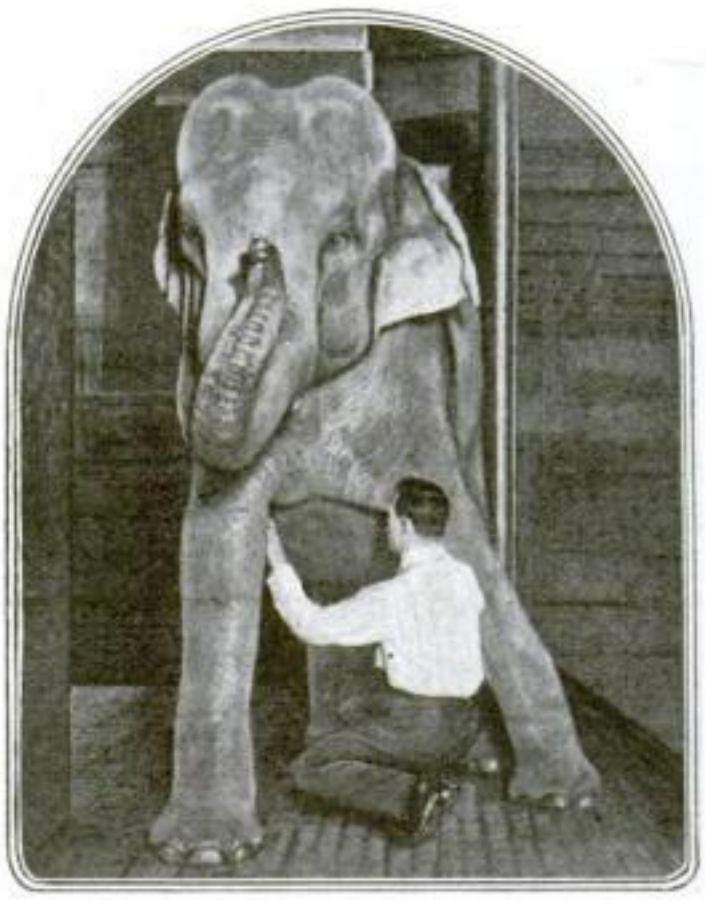
Looking at the picture below might cause one to marvel at the Chinese woman's seeming disregard for appearance, until the Occidental bustle and crinoline are recalled.



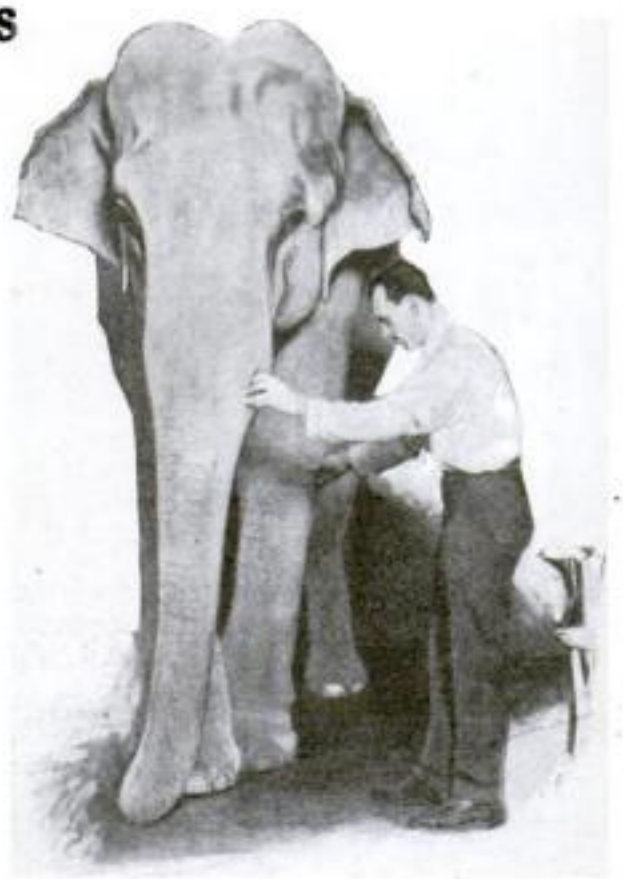
How a Five-Ton Elephant Learned Modern Dancing

One of the Hippodrome stars

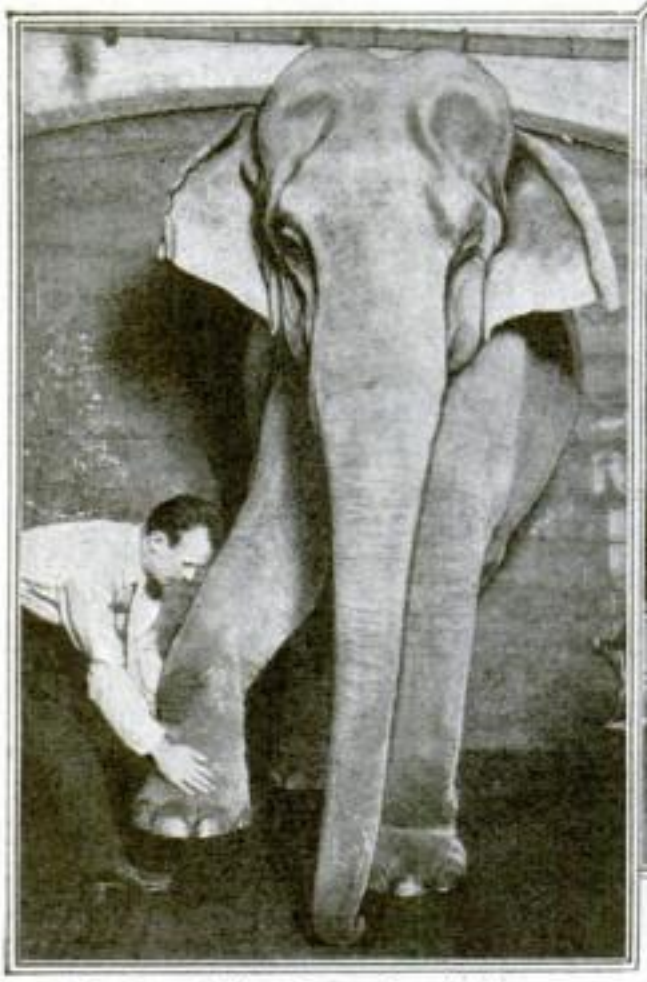
George Powers, of the New York Hippodrome, taught five-ton Jennie, born in India, to dance. He played a dance record on the phonograph until Jennie got accustomed to it; then he stopped the phonograph and lifted Jennie's front feet in time to his count



At first she did not realize that she had to sway her whole body to Powers' count. She thought it enough to sway her trunk and head. So he indicated to her what he expected by pushing her from side to side



As soon as Jennie understood that Powers wanted her to lift her feet in time to his count, she did it voluntarily. He guided her steps so that, at a cost of much time and perseverance on the part of the man and the elephant, she learned just how to place her feet



After her daily dance Jennie likes to shake hands with her master and dancing partner.

She is immensely pleased when she has mastered a new trick and shaking hands is her way of telling Powers so

At last Powers turned on the phonograph again, and Jennie heard the record she had heard so often for so many days before her "dancing" lessons began. Immediately Jennie started to dance in time to the music. Powers took her by the trunk and danced with her. She soon learned to match her steps to his

Jennie's reward is some delicacy she fancies. Here Powers is giving her an apple. Powers never hurts or intimidates his elephants. He says as soon as an elephant understands what is wanted, the big animal tries its best to do it

Some New Jobs for the Clothes-Wringer

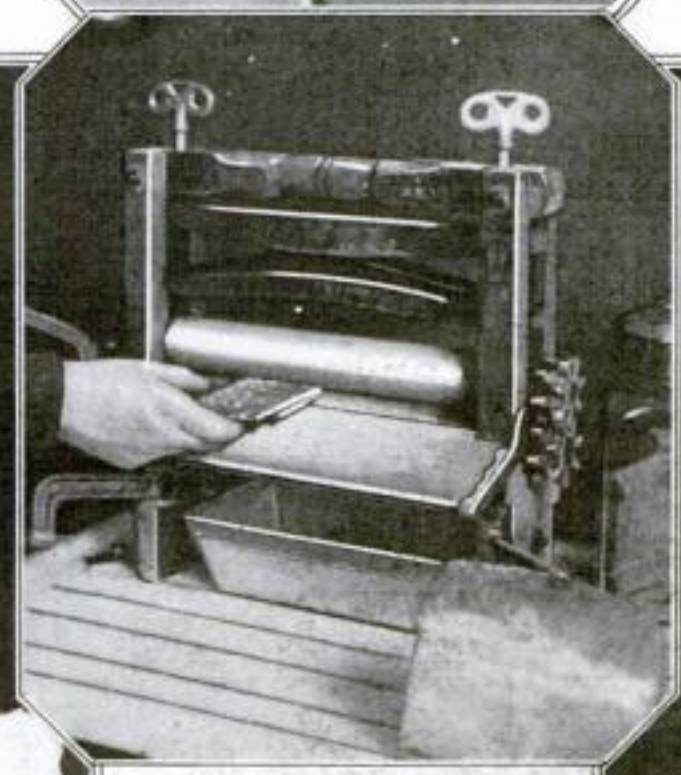
Should it be idle six days a week?

This woman knows all about the ordinary use for the clothes-wringer. It has probably never occurred to her that it can be utilized in other ways, as demonstrated by the five pictures shown on this page.

If the butcher cuts your bacon too thick for your particular taste, don't be annoyed. Instead of sending it back and demanding more, slip it through the wringer. It will be thin when it gets through

A creased knitted tie, placed on a wet bath-towel may be run through a wringer to restore it to its youthful freshness. This will eliminate the creases without injuring the tie one particle

If you have some hard nuts to crack, let the gears of the wringer do the job for you. Place your adamant nut between its teeth and give the handle a short, sharp turn. The meshing teeth will crush the shell



"Dip in cracker-dust and fry," reads the recipe. If you have crackers in the house, you can soon have the required dust by running them through the wringer

Pots and pans mean a great deal to many men who, before prohibition, kept out of the kitchen as much as possible. One of these men is here seen squeezing the juice out of a bag of fruit

Floors covering large areas can be cleaned by an electric scrubbing-machine, which does the work of fourteen men

Scrubbing Floors Electrically

THE days of drudgery for the scrubwoman are numbered owing to the perfection of a new automatic scrubbing-machine. It is portable, and is easy to operate. Attach the machine to any electric-light circuit and it is ready to use.

A large machine with three operators has cleaned 5600 square feet in one hour—work equivalent to that performed by fourteen hand-scrubbers. The work is divided into three operations. First there is the scrubbing-machine, operated by one man; next is the mop-man with a water-absorber tank and mop to clean the scrubber wheel-tracks and foot-tracks; and finally a sub-station, consisting of a weighted stand carrying an auxiliary cable for use where the cable on the scrubber is too short to reach from the farthest point to be scrubbed to the nearest light-socket.

The machines can be equipped with different brushes to suit different kinds of floors.

An Automobile for One

NO longer is it necessary to get out the big touring-car when only one member of the family wishes to ride. In the garage, or in the basement is a little vehicle that will convey a single passenger in comfort.

In a small space the complete mechanical equipment of an average automobile—the engine, gear-box, fly-wheel, clutch, and shaft-drive—is arranged. The engine of 2½ horsepower is of the standard two-stroke pattern, which has a heavy outside flywheel in which is housed the clutch, behind which is the two-speed car type of gear-box. The drive is taken to the worm-driven rear axle through a short shaft that runs into an aluminum casting containing the whole rear-axle equipment. The machine is started by a handle manipulated from the seat, and the control is from the handle-bars.

Economy of fuel, ease of travel, and speed are combined in this adaptation of the motorcycle.

Traveling at thirty miles an hour this little machine can go more than eighty miles on a gallon of gasoline.

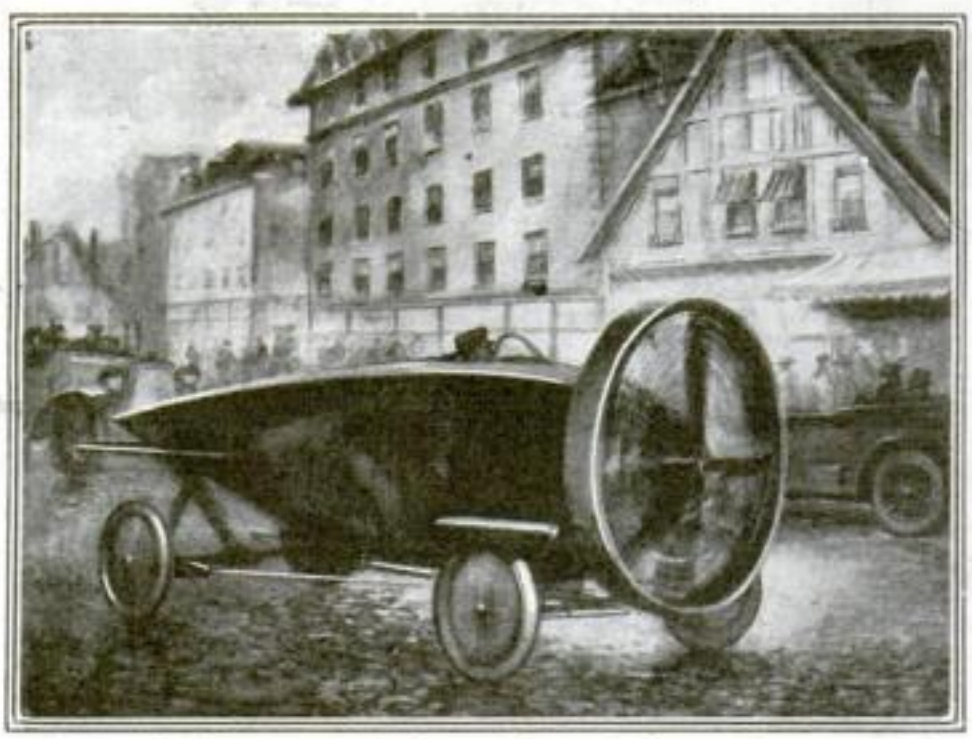
The two-wheeled "automobile." Above is shown the compact arrangement of the mechanism. At thirty miles an hour the traveler can make eighty miles on one gallon of gasoline

Driving a Car by an Air-Screw

IMAGINE a streamlined body of an airplane running on three wheels, two in front and one in the rear, propelled by an airplane propeller placed at the front.

During the war the Germans employed airplane propellers for the propulsion of freight-cars. The land car shown in the accompanying picture is the invention of Leyat, a French engineer. The body of the car, which is set on three or four wheels, is streamlined so as to offer the least resistance to the air. In the original model the driver occupied the seat in the front cab placed directly behind the propeller, while in the later models the cab has been abandoned and the driver occupies the cockpit with only his head showing above the top of the car.

The driving mechanism consists of an eight-horsepower two-cylinder gasoline engine of the V type, air-cooled and connected directly with the four-winged propeller. The engine is placed in the front end of the car, before the driver. Behind the driver's seat is a seat for one passenger, while the sharply tapering rear of the car contains a gasoline tank and space for tools and baggage. The rear wheels are used for steering, while the front wheels serve for braking the car. Tests show that a car of this construction can easily make fifty miles an hour, using about three quarts of gasoline. With the brake system used a car of this kind going at a rate of twenty-five miles an hour can be brought to a complete stop within fifteen feet.



A French inventor took a lesson from aviation and constructed a streamlined body automobile carrying an airplane propeller

His Chance to Make Good

With burnt hands he plugged the roaring, leaking boiler

By Edward J. Veronda

JACK HARDING glanced at every piece of machinery as he passed it—he had the born engineer's unconscious habit of taking in every detail. Nearing the switchboard, he noted the readings of the meters, then paused in the doorway of the fireroom.

The heat of roaring furnaces rushed out at him as he stood staring down the tunnel-like space.

"Allen!" he called to a scantily clad, grimy-faced stoker. Allen, resting on his shovel, turned. "The chief had to go away," said Harding, "and he left me in charge. Is everything all right in here?"

The stoker cast a glance toward the boiler. He hesitated uncertainly.

"I was just going to report that there is something wrong with Number Six boiler, sir. She ain't taking in water right."

"What seems to be the trouble?" asked Harding.

"Something wrong with the pump," responded the stoker.

A Leak in the Pump

Harding entered the fireroom. On the right side of the aisle was a row of huge black boiler ends. Across the way were the bunkers, piled high with good steam coal. Between each bunker and the one next to it a busy pump worked.

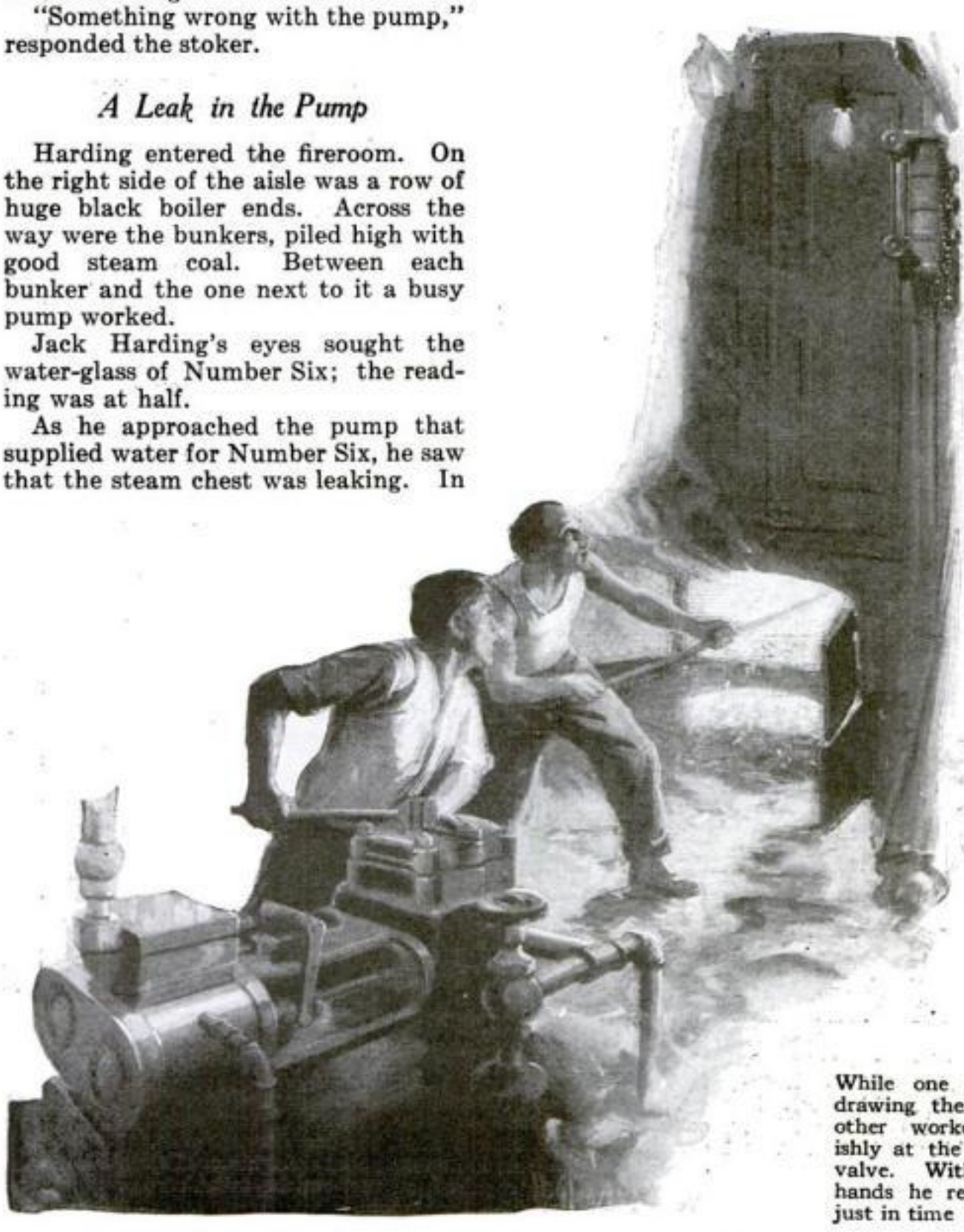
Jack Harding's eyes sought the water-glass of Number Six; the reading was at half.

As he approached the pump that supplied water for Number Six, he saw that the steam chest was leaking. In place of the steady clank of an honest pump, this one was sputtering and fuming crazily. The trouble was slight enough, but it must be remedied at once. If the damage was not repaired before the water in Number Six boiler was exhausted, the fire under it would have to be raked out, thus reducing the amount of steam fed to the engines. Some circuit would have to be cut out, and this would mean darkness in some part of the city that night—the very thing he had been given the opportunity to prevent!

Stepping quickly to the engine-room, he seized hammer and chisel and hurried back to the pump.

Dropping on his knees beside the pump, he set to work. The narrow space cramped him, the escaping steam burned his hands; even the chisel grew so hot that he could hardly hold it.

And when he finally plugged up the leak the valve did not respond!



While one man was drawing the fire, the other worked feverishly at the defective valve. With scalded hands he replaced it just in time

"She's Near Dry"

There was something more than a leak, he realized; the trouble must be in the valve itself.

"She's near dry," came Allen's swift warning. "She ain't safe!"

His voice was husky and his eyes measured the distance to the doorway, though beyond this he showed no sign of wavering.

"Draw the fire," directed Harding.

Despite this, Number Six continued to vibrate dangerously, quivering like an animal on the point of springing.

Down on his knees, Jack was pulling the pumps apart; his hands were burned nearly raw. And he raged when they fumbled. Probing into the pump, he found the trouble at last—a stone wedged in the valve! He picked at it with his fingers, then with a screw-driver—it would not come out! He got up, ran to the bench for a new valve, and hurried back. The ruined valve came away, and he inserted the new one, quickly driving in the screws.

The internal noise in Number Six was now a roar, and the safety valve let out an increasing scream. He tried to work faster, and as he worked he considered the matter a little hysterically, though his hands worked none the less steadily. Driving home the remaining screws, he forced the valve of the cylinder in place.

The noises from the belly of Number Six were dreadful now, and it was beyond the power of man to listen to them with a steady heart.

As the boiler vibrated, the great steam-pipes vibrated with it. The walls of the building took it up and trembled also, not in unison at first, but finally in perfect harmony. Harding felt as if this vibration would drive him mad. His very bones trembled to the tone of the boiler.

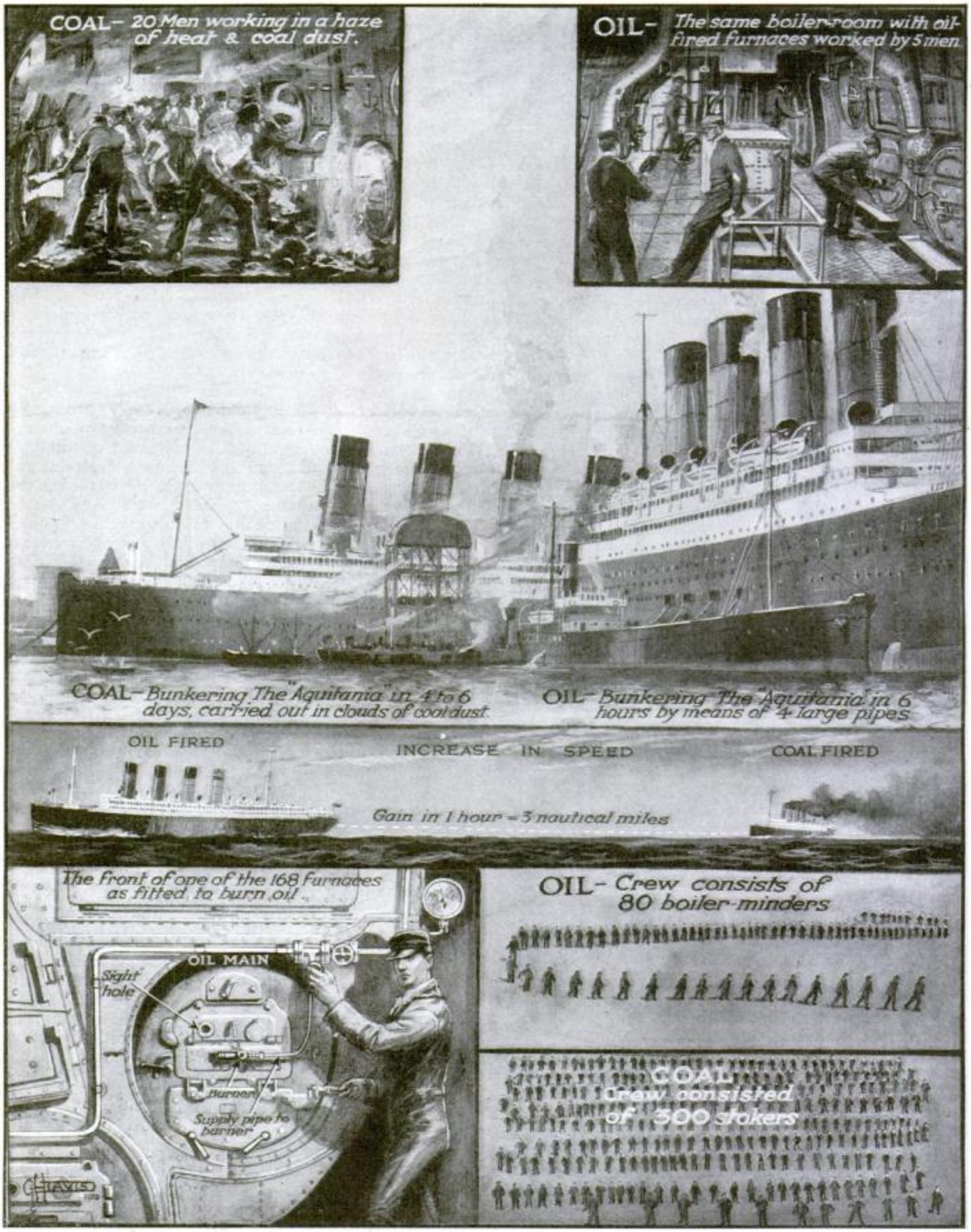
He twisted the last nut, fumbled for the cock, and threw on the steam into the chest of the pump. There came a gurgling, choking sound, then a sharp click, the unmistakable noise of a working pump.

He reeled backward. "Is she working, Allen?"

"Sure," answered the stoker. "And if fire ain't put under Number Six she'll be having the chills."

Jack stumbled out into the sunshine. He had made good—his opportunity was won!

Installing Oil Fuel on a Great Ocean Liner



Drawing by G. H. Davis

THE use of oil fuel on ships is, of course, not new, but the conversion of the *Aquitania* into an oil-burning steamship is a matter of universal interest. It comprised the removal from boiler-rooms of ash-expellers, furnace fronts, fire-bars, etc., weighing 300 tons. The weight of new material amounted to 745 tons.

The main storage-tanks (in sections) extend along both sides of the ship for a distance of 369 feet. There are also three large athwartship tanks. The total storage capacity is 7780 tons of oil.

The tremendous advantages of oil over coal are graphically pictured in the drawing above. "Bunkering" is done in hours instead of days, the traveling speed is increased, and whereas in handling coal three hundred stokers were formerly required, oil fuel can be taken care of by a crew of eighty boiler-minders.

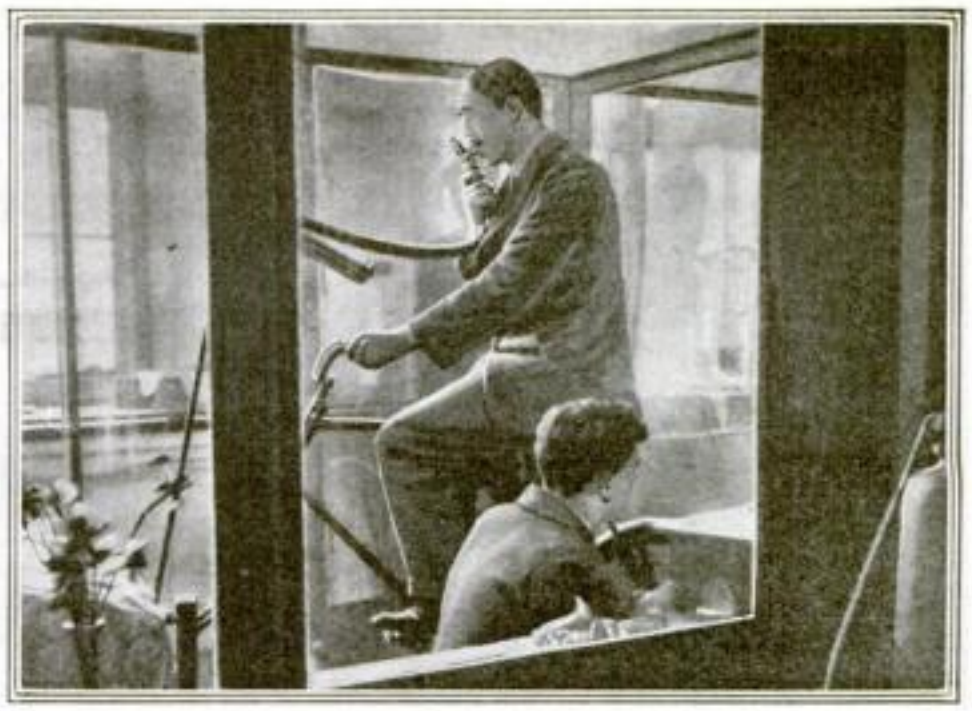
Stage Settings from Blocks

A NOVEL but very effective stage setting first used in the production of French plays in New York city, was based entirely on a system of angles. When the stage director for the French Players in New York is ready to plan a scene, he goes to his drawing-board and draws a diagram of the stage. Then he takes pieces of dark-colored paper, cut in the form of squares, and fits them on the diagram until he obtains the effect he seeks. The little squares of paper are all cut according to scale, each square representing so many feet on the stage. After the stage setting is all worked out on the drawing-board, the director is ready to set the stage for rehearsal.

Once the preliminary work was done in the studio, it was only a matter of a few minutes to set the stage. Back of the stage are piled numbers of square blocks and several other blocks in the shape of steps. Two of these steplike blocks, fitted together, make one large block, about four times the size of the plain square blocks. Beside these curious-looking blocks stand lattices, doors, and windows. At the back and at the sides of the stage are permanent wooden pillars. The lattices, doors, and windows were so made that they fitted between these pillars. They are all made in such a way that they are interchangeable. It is not necessary to have two sets of scenery, yet, when the stage is set, the scenes presented have an entirely different appearance.

This type of scenery lends itself to the production of both outdoor and indoor scenes. Almost any arrangement of a simple or formal garden can be accomplished with the blocks and lattices, while out of the combination of the interchangeable doors, windows, and blocks can arise a room suitable for a peasant's hut or a king's palace.

With these blocks is built up any scene that may be required, from drawing-room to garden, from a peasant's hut to a king's palace



Mr. Barcroft of Cambridge, England, exercised on a stationary bicycle during his imprisonment in a glass case

In a Glass Case for Six Days

IN the interests of aviation, Professor Barcroft of Cambridge University spent six days in a hermetically sealed glass case. Nitrogen and oxygen were constantly pumped into the case, but the amount of nitrogen was increased while the oxygen was decreased. Thus the atmospheric conditions within resembled those experienced by aviators flying high.

At the end of the six days blood was drawn from Mr. Barcroft's arm and carefully examined. As for the effect on the experimenter, he became very restless toward the end. He was unable to sleep and lost his appetite entirely.

Mount a Flashlight on Your Automatic

"HANDS up! Quick!"

A flash of light envelops the would-be burglar and blinds him.

"Drop that gun!"

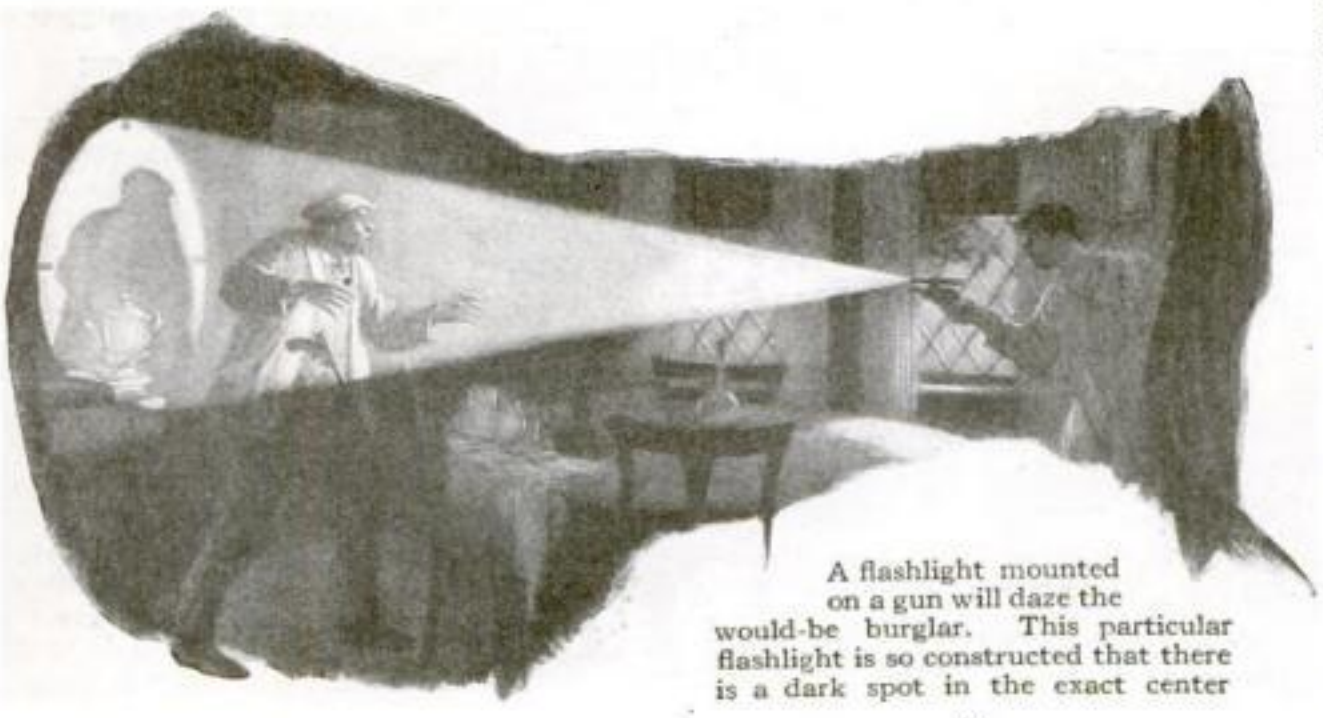
Dazed by the light, he drops it.

His captor, in the meanwhile, is perfectly calm and sure of himself. The light that is blinding the burglar is a flashlight attached to his gun parallel to the barrel. Thus he knows that his gun is in line with the light.

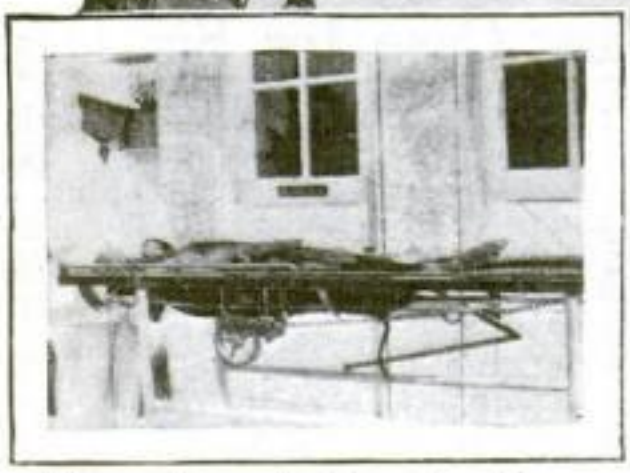
Furthermore, the flashlight is so constructed that there is a dark spot in the center. As the light flashes on the culprit, the dark spot stands out and shows the captor just where his bullet would hit should he need to fire.

The burglar knows nothing of the man who covers him; that man may be smaller than the burglar, or he may be much larger. In any event, the burglar decides not to take any chances and he therefore promptly gives up without a struggle.

The flashlight is parallel to the barrel of the gun; thus you are sure of your aim



A flashlight mounted on a gun will daze the would-be burglar. This particular flashlight is so constructed that there is a dark spot in the exact center



When Inoculating the Pig

PERHAPS, at first glance, one would think that this was a device for pulling a pig apart limb by limb. It is not, however. It is merely used to keep the animal quiet while it is inoculated with an anti-cholera serum by experts of the United States Department of Agriculture.

Pigs are very susceptible to cholera, which is a highly infectious disease, and a continuous battle is waged against it by breeders everywhere to prevent it from spreading.

Although the "operating-table" in the picture looks like an instrument of torture, it is not at all painful, but effectively prevents the pig from squirming while the inoculation is being made. So tightly is the pig held that he cannot move an inch; all he can do is grunt.

Ice-Pegs to Start Sleds

YOU don't need hills for bob-sledding if you are willing to "peg away." Grasp a sharply pointed peg in each hand and dig them alternately in the ice. You and your sled will start to move slowly, but gradually you will gain momentum. The faster you peg, the faster you will go.

A peg race is great sport, and many of the visitors at Lake Placid are peg-racing this season. The picture above shows the start of one of these contests for ladies. The onlookers enjoy it as much as the contestants.

Besides the excitement and pleasure in a race like this, it is also physically beneficial. Both arms are exercised equally. There are few sports in which this occurs.

Gas from Peat

PEAT is now being used for the production of gas in especially designed producers. The yield compares favorably with that of coal, and many valuable by-products are produced. This method of using peat has been found to be the most effective, since it is not necessary thoroughly to dry the crude material.

Plants for the manufacture of gas from peat are in operation in Germany, England, Ireland, Sweden, and Italy.

Removing a Double Chin

A DOUBLE chin is the deciding factor that places its owner in the heavy-weight class. It is the one thing most feared by women who have reached the stage known as "pleasingly plump."

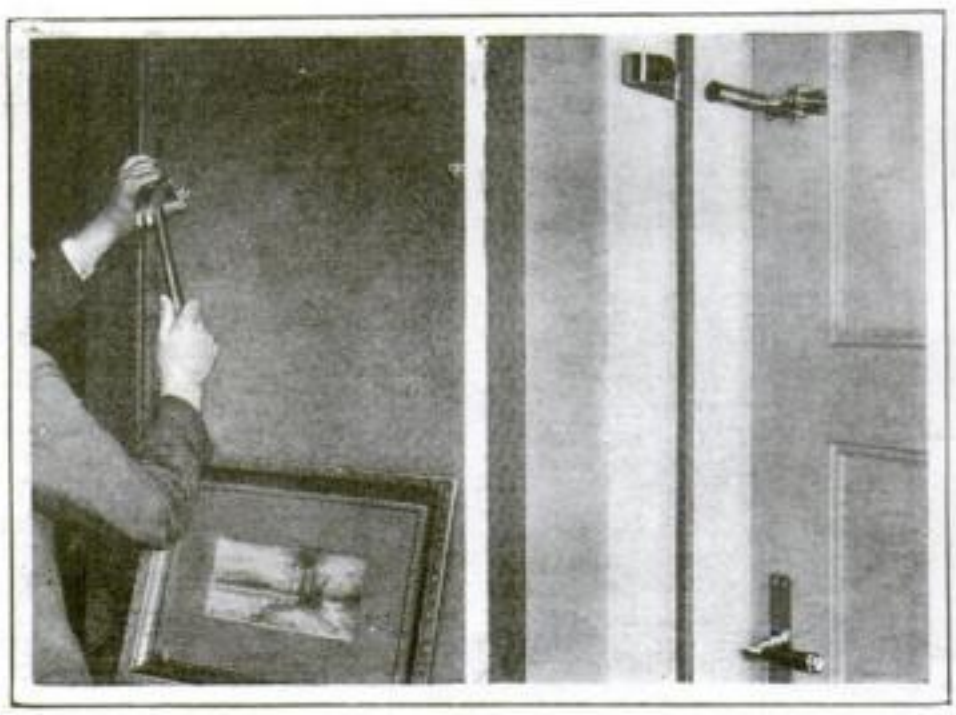
Now, however, there is a double-chin remover which can be operated by the owner of the chin in the privacy of the home.

The machine is mounted on a small stand. Two wires extend from it to the sides of the band which the wearer straps under her chin. She turns on the current, and her chin, invigorated, tries to fall back into place, and once more electricity has jumped into the breach and justified its value in the household, each year finding it more strongly intrenched than it was the previous year.

Hooks that Will Hang the Picture Straight

ONE crooked picture will make a room look untidy. There is a new picture-hook that is supposed to prevent this. It is made of strong, flexible wire arranged in a series of loops, with a sharp point at one end. The point is driven into the wall and the loops are adjusted until the picture is perfectly straight in its place.

When you take the picture down and wish to remove the hooks, do not pull them out. Instead, pull the loops backward and forward a few times; they will break off and leave the stem behind them.



A Check to Keep Doors from Banging

THE easily attached door-check shown in the illustration will prevent the banging of doors.

It consists of an arm bearing a spring coil ending in a soft cushion. This arm is pivoted to a base screwed to the lock side of the door. The arm moves horizontally only, and is held in position by a tension spring that can be regulated by turning a set screw.

At the same level a clamp is attached to the door-jamb so that it is ready to receive the padded end of the door-check whenever the door is banged shut.

Pictures Teach Dancing

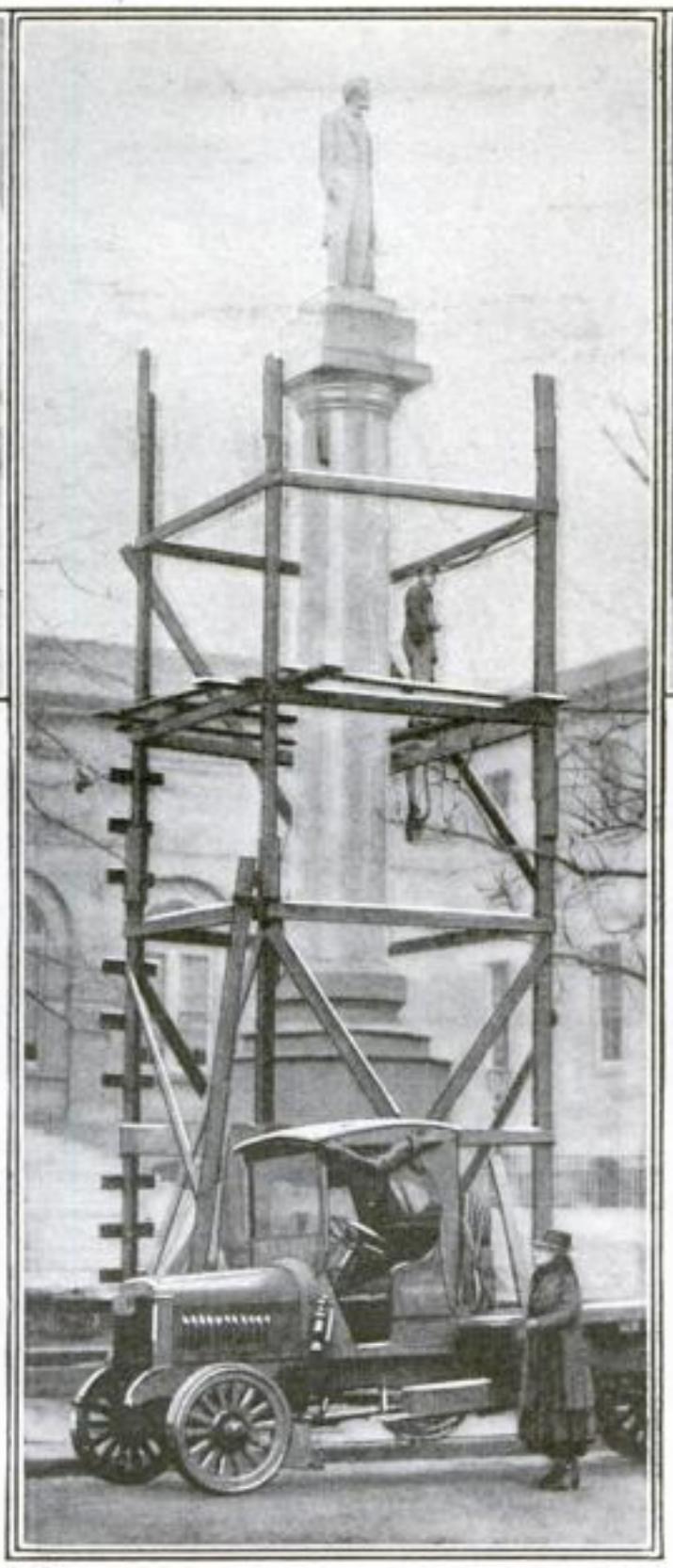
NOW there is a moving-picture device to teach people dancing, step by step.

An expert dancer performs in front of a moving-picture machine, the action being so timed that he does a complete movement in exactly forty-two pictures. The pictures are enlarged and printed on paper. An outline of each picture is sketched, and from these small cuts are made. The printer "pulls" proofs and these are used in machines like the one above.

The pictures are placed in succesive grooves in a drum that is rotated rapidly, producing the illusion of motion.

The Largest Belt Yet

A BELT like this is used in conveying materials from one part of a large factory to another. It is the largest belt ever made for this purpose. It is one thousand feet long and forty-eight inches wide, and contains twenty-nine thousand feet of rubberized fabric. This is enough to cover the floor space of the largest gymnasium in the country more than two and one half times.



© Harris & Ewing

Moving-Day for This Monument of Lincoln

SHORTLY after Lincoln's death a monument to him was erected in front of the district courthouse building in Washington. For fifty years this tall monument with its life-sized statue of Lincoln on top, has adorned the vicinity of the old courthouse building.

Recently the building was reconstructed, and now the statue is considered to be out of harmony with it! As a result, the statue is being moved to a more appropriate spot near the Potomac.

Many of the residents of Washington have protested against the removal, but what chance have mere individuals in an argument with a courthouse?

A Collapsible Cane

EVERYTHING has a time and a place—especially canes. Therefore why not use a collapsible cane that, when shut, will fit in your pocket? Such a cane has been invented by Frank Kutwicz of Regina, Saskatchewan. You will always be able to carry it with you and take it out when circumstances permit.

The cane comes in six sections, all hinged together like a folding foot-rule. Each section possesses a small blade that fits into a socket in the adjoining section. These blades make the cane rigid when it is erected. When you wish to fold the cane, you release the blades.

Checking Up the Coal-Dealer

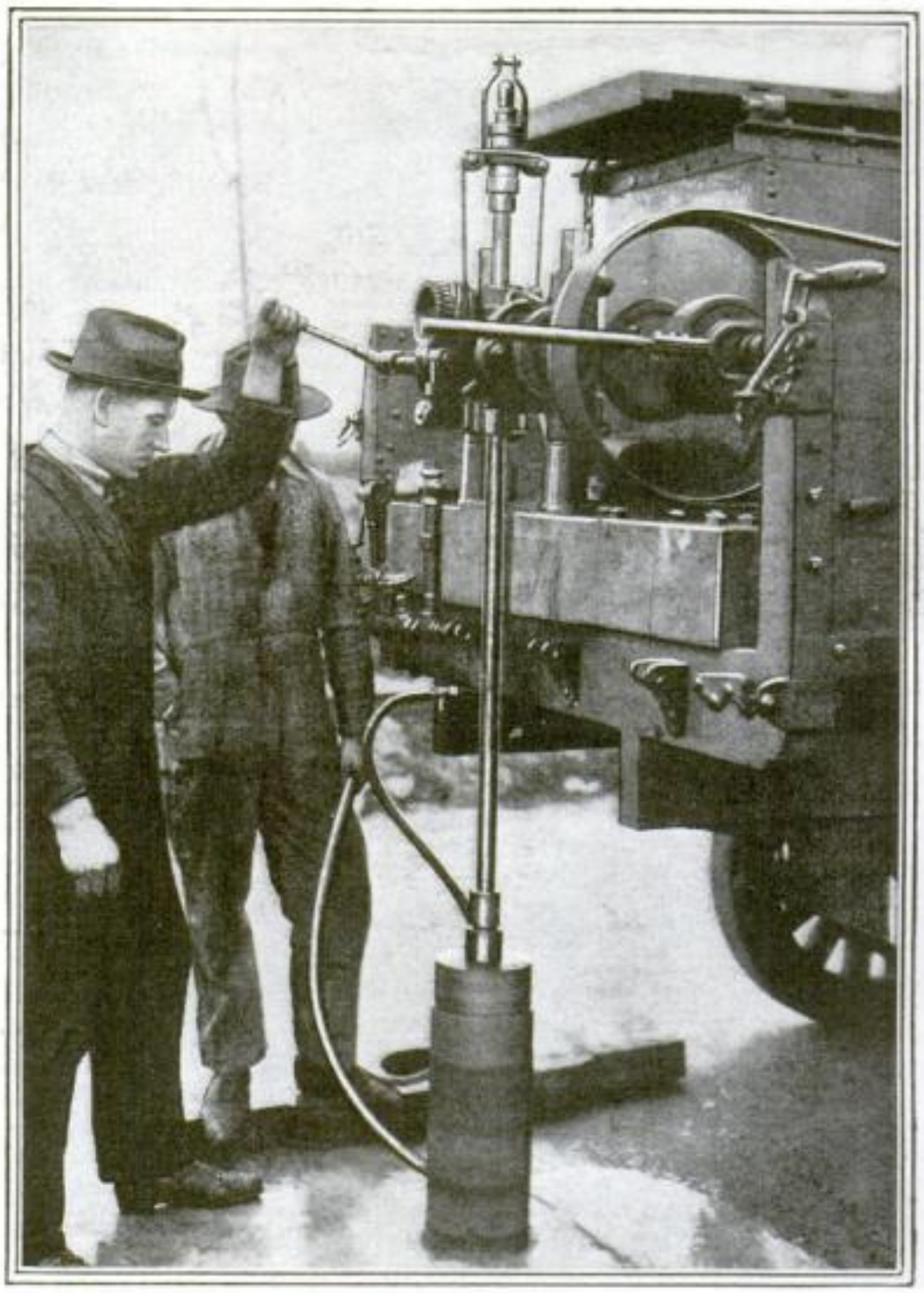
THE coal-dealer must give full weight if his customer uses one of these coal-meters.

The coal passes through a chute in the center of which is a rotating vane that is moved by the passing coal. A dial records how much coal has been thrown down the chute. On the device is arranged a counterweight that cuts off the passage of the coal unless a solid column is running through. If a small amount of coal were allowed to pass, the vane would not operate and the dial would not register.

Rubber Caps Prevent Short Circuits

ELECTRIC wires can be protected from any possibility of becoming grounded or from being short-circuited. This is usually done with tape as an insulator, but sometimes the tape is stretched until it becomes dangerously thin and, in time, more or less worn.

The danger of short-circuiting is entirely eliminated by the use of small rubber caps easily twisted over the spliced ends of the wires. There are two sizes, and it takes only about three seconds to put them on. When the tape is wound around the rubber cap, the insulation is doubly strong, and the chances of loss of current through contact with moisture or of short-circuiting is entirely avoided by this simple method.



Carry Your Own Cigarette-Stand

IF you go into a house where smoking is permitted but not indulged in by the members of the family, you are not apt to find an ash-tray on which to park your cigarette.

But if you carry in your pocket the small cigarette-stand shown above, you need not depend on the ash-trays of others. The stand is made of silver, and is so constructed that it will fold up and fit in your vest pocket.

Unfortunately, no provision is made for the ashes that are bound to fall off the end of your cigarette; it is up to you to dispose of them yourself. We would suggest that you carry a small receptacle in another vest-pocket and use it for your cigarette ashes.

Drill-Presses and Production

SHOWN below are drill-presses that represent a radical departure from the ordinary type. The bushing-plates are attached to the drill so that they may be adjusted vertically. The jig, which holds the casting to be drilled, rolls on V-shaped rails from machine to machine.

The first machine drills the holes, the second reams them, and the third counterbores and countersinks them. A continuous procession of castings passes under the drill.

At the end of the row, the finished casting is taken out of the jig, and the jig is returned on another rail to the first machine.

Taking a Sample of Pavement

THESE men are not drilling a well as you might think. No; they are obtaining a sample of pavement so that they may take it to a laboratory to put it under tests.

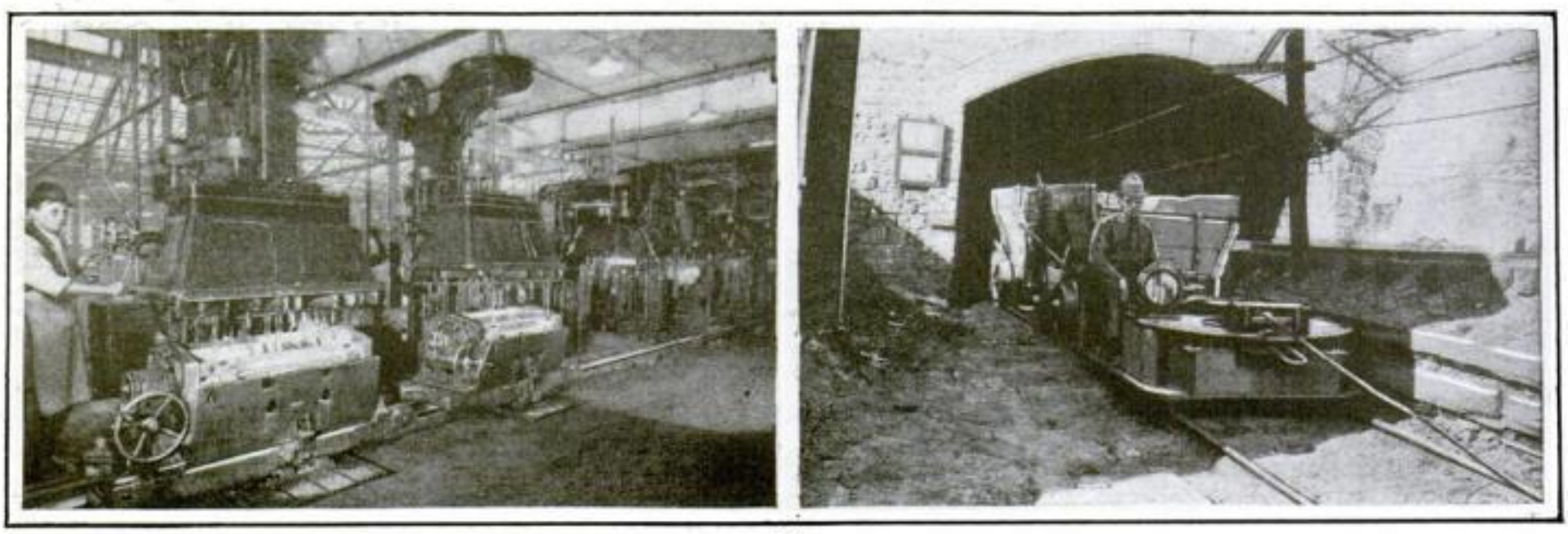
This machine displaces several men working with pickaxes and chisels.

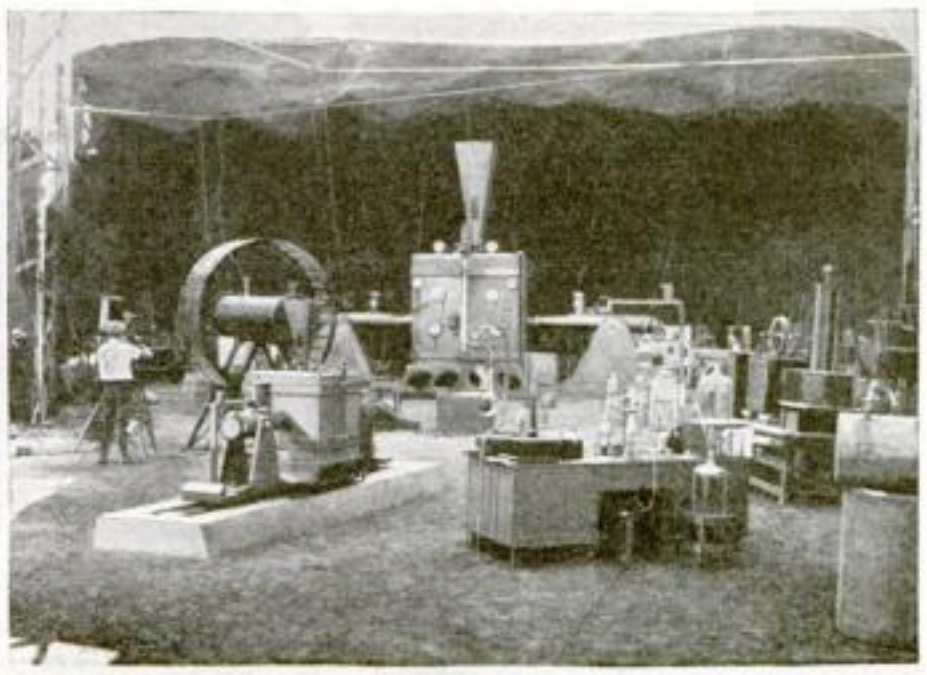
The drill is made of chilled steel and has steel shot as its cutting medium. It is placed in contact with the pavement, flushed with water, and set in motion. It cuts a perfectly round hole, and the concrete from this hole is used in the tests that follow. The concrete is removed in the form of a core. This is tested for thickness, wear, abrasion, and resistance.

A Mechanical Mule

LIKE a regular mule, this mechanical mule is driven by reins. The "reins" are really control cables that are connected with the electric motor that drives the mule. Instead of saying "Giddap," the driver merely operates a switch and the mechanical mule, unlike its namesake, starts off without any delay.

This little machine is an infant mine locomotive weighing eighteen hundred pounds. It is but twenty-six inches high, and this enables it to get in parts of a mine where mules could not go. It will also travel over very light track, even though it be poorly laid.



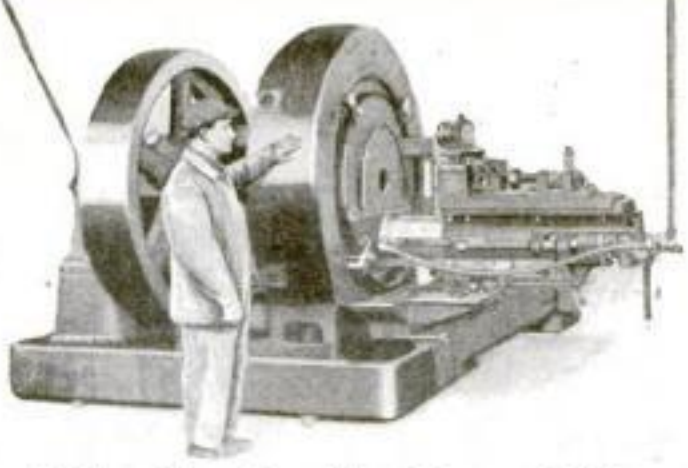


Is This a Boat or Is It an Airplane?

THIS looks like a cross between a Chinaman's junk and a seaplane. The electrical engineer who designed this mysterious craft refuses to tell the public just what it is all about. He has christened it the *What-Is-It*. Everybody who has seen it is interested in knowing just what it is to be used for.

The superstructure rests on three pontoons or floats. The stern float also serves as a rudder, and it is turned with the wheel in the bow.

The boat—if we may call it such—is here shown starting on its trial voyage. It is a mystery to us, but we heartily wish the inventor every success.



A Hot-Swaging Machine to Make Heavy Tubing

MANY advances have been made in the methods of forming metals by cold-swaging processes, but the hot process has been developed to be used principally on heavy work where a great deal of reduction is desired without annealing. A new machine handles tubes as large as five and a half inches in diameter and solid rod of two and a half inches in diameter.

As the spindle rotates, the hammer-blocks are thrown away from the center by centrifugal force and the dies open. The twelve head-rolls project toward the center beyond the path of the hammer-block rolls and as the rolls pass each diametrically opposed pair of rolls, they are forced toward the center of the machine and carry the hammer-blocks and swaging dies with them. As the head rolls are passed, the hammer-blocks and dies are thrown automatically apart again.

The work is held rigidly and concentrically with the dies by pneumatically operated clamping jaws bolted to a saddle which moves forward and backward on its slideways by hydraulic pressure. Feeding is controlled by a hand valve. The holder and cover are self contained and hung on a hinge so that easy access to the dies and working parts of the machine is secured.

Diamonds Manufactured—This Time in the Movies

DON'T get excited. The diamond market is not wrecked yet. It will probably be some time before it even begins to totter. If movie-men really knew a process for the manufacture of diamonds, the production of movies would no longer interest them.

This formidable array of mysterious-looking apparatus was assembled at great expense for a serial picture. From the movie-man's standpoint, the illusion is perfect.

From the scientific man's standpoint, it is just about what a movie-man's idea of a diamond-producing apparatus would amount to.

Blowing Glass Eyes to Order

GLASS-BLOWING as an art goes back to ancient times, but its application in making artificial eyes belongs to modern times. The art is delicate, especially in the matter of obtaining the right tint of color for the iris. Eyes that do not match are worse than none at all as far as appearance is concerned.

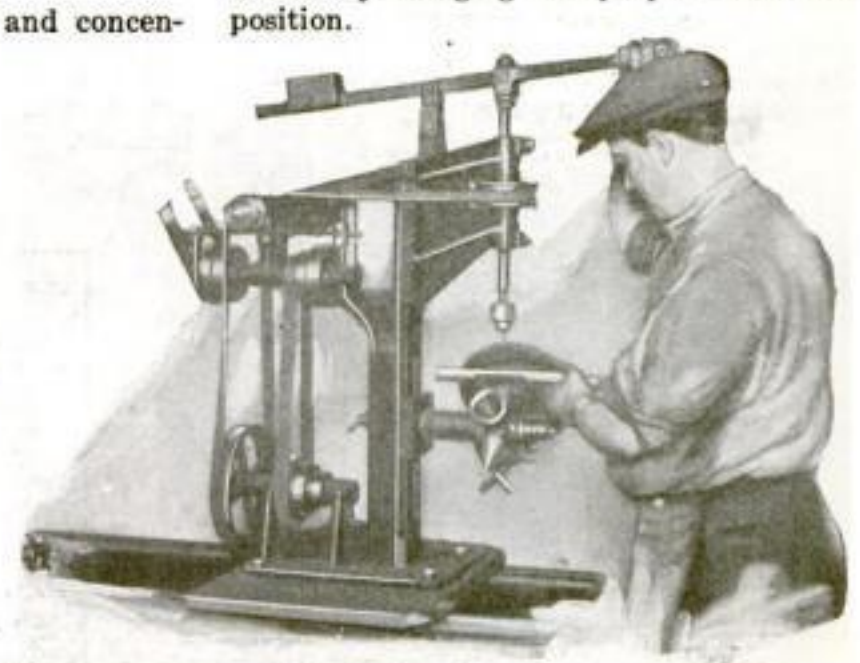
The war caused a huge demand for glass eyes, and many manufacturers are kept busy making them.

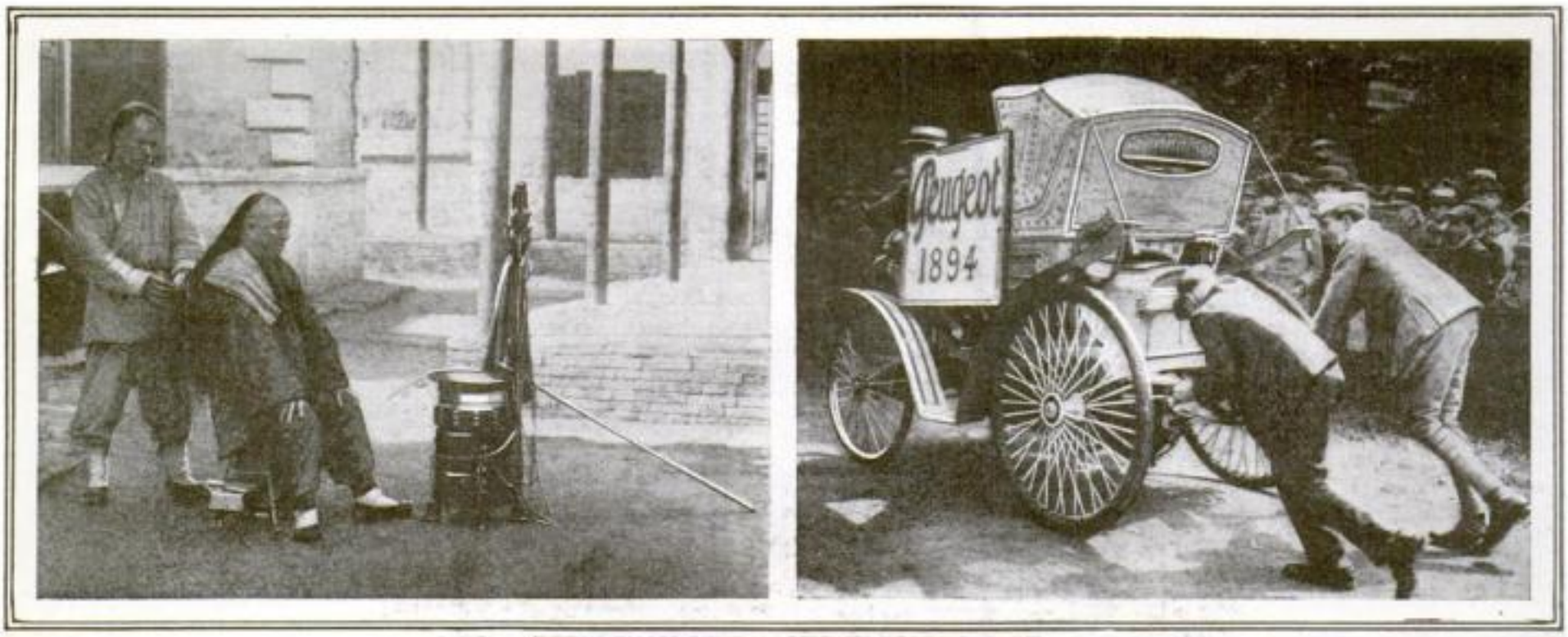
The enamel on the front of the eye must always be perfectly smooth or the eyelid will become irritated. When this enamel becomes worn, the wearer should get a new eye.

A Drill-Press of Many Uses

IN place of the ordinary table, this little drill-press has a revolving member carrying on it different forms for the various classes of work. There is a V-block, a cup, a point, an angle, and a flat table. Any one of these may be brought into position by merely turning the casting which is mounted on a shaft.

The movable member locks into position when any one of the forms is in exact alinement with the drill in the spindle. A man is here shown using the V-block in drilling a hole through a rod. Pins, shafts, collars, balls, or angular pieces may be drilled by bringing the proper form into position.





Why the Chinese Are Cutting Their Queues

WITH the fall of the Manchu dynasty came the wholesale barbering of queues. The barbers of China were very busy people, and their art is now developing to that of the normal tonsorial stage.

In the early part of the seventeenth century, when the Manchu Tartars invaded the country, they found the men wearing long hair tied in a knot upon their heads. But on the conquest of the country the inhabitants were compelled to adopt the queue, or long pigtail, often greatly lengthened artificially by employing long strands of black silk thread.

To celebrate the fall of this dynastic rule the Chinese were eager to have their queues removed, after the lapse of three centuries.

Skull Rock in Colorado

THERE are several famous rocks in various parts of the country that are shaped like the human head; but you must go to the Rocky Mountains if you wish to see a rock that is shaped like a skull.

"Skull Rock," as it is called, is located near Canyon City, Colorado. It juts out from the side of the mountain on which it is located, and is clearly outlined against the sky.

If Hamlet had seen this monstrous skull, how he would have soliloquized!

At Canyon City there is a road known as the "skyline drive." As you travel along it you see a range of mountains outlined against the sky. Skull Rock stands out sharply, with its eternal reminder of the transitoriness of man's life.

© Kadel & Herbert

Picking Up Marbles with the Toes to Cure Flat Feet

ARE you flat-footed? If you don't know, the next time you take a bath, observe the impressions that your wet feet make. If your feet are normal, there will be a narrow line from heel to toe on the outside; if they are flat, the entire bottom of the foot will show.

How can you correct flat-footedness? Buy a handful of marbles, place them in two rows, and start picking them up with your toes. To do this you must curl up your toes; as a result the muscles of the feet will be exercised and thereby strengthened.

The Old Horn as a Funnel

IF the electrical end of your automobile horn is irreparably broken, find new uses for the various parts. Take, for instance, the cone-shaped horn proper. It may be used as a funnel.

Your car is apt to run dry when you are miles from a garage. The nearest farmer will give you a pail of water, and the horn-funnel will guide the water into the radiator.

How the Pioneer Automobiles Were Started

PUT her in gear and push. That's one of the remedies for a car that won't start—and a good old-fashioned remedy, too. For that's how the first automobiles ever made had to be started.

Above you see a Peugeot automobile that was built in 1894. It is still in existence and is occasionally exhibited at the French automobile shows.

The engine is full of life, even though it is more than twenty-five years old, and a few healthy pushes will start it off. The wheels are much larger than the wheels of the automobiles of today, and the tires are made of solid rubber. This automobile was one of the first to be built in France.

Beheaded by an Earthquake

ONCE there was a woman who hated the thought of passing out of this world without leaving some concrete image of herself behind. And as she had plenty of money to satisfy her whim, she had the concrete image made. It was dressed concretely in clothes that were stylish at the time—a tight-fitting coat and a wide skirt.

For years, now, it has been sitting on the edge of her tombstone, which is situated in a Los Angeles cemetery, holding a concrete satchel in its hand. Recently, however, there came an earthquake which respected neither tombstones nor images. It knocked the head off the concrete woman, and deposited it alongside of the satchel.

"All the king's horses and all the king's men" will be needed to put her together again.

It's Tea-Ball and Teapot Too

EVERY one knows that the flavor and color of tea-leaves will percolate through any perforated container, regardless of its shape, although heretofore a ball has been the usual shape.

A tiny teapot, for instance, if properly punctured, will serve the purpose. Below you see just such a teapot. It is made of silver and dangles at the end of a small chain. The lid opens to let in the tea. If you hold it in a cup of hot water for a few minutes, the water will become tea.

A Beer Sign for the Illiterate

LOOK closely at the picture below and you will notice a sign entitled "Bor es Sör," and above these words a picture of seven foaming glasses of beer, and a tray on which are seven beer bottles!

This store is located in Budapest—a long way from the United States. The reason for this artistic beer display is that many of the poorer people in Budapest are unable to read. "Bor es Sör" would mean no more to them than it does to us, were it not for the picture.

Acrobatic Japanese Firemen

HAVING a population of nearly three million people and with houses of generally flimsy construction, the city of Tokyo, Japan, requires a well drilled and efficient fire department.

Because there are no skyscrapers, the fire-fighting apparatus is remarkably simple compared with that of American cities. But the skill of the firemen as acrobats cannot be doubted when one witnesses them engaged in a practice drill.

Here they are seen poised in difficult positions on the top of tall ladders, a feat often performed on the stage by Japanese acrobats in foreign countries. Numbers of us have seen these acrobats perform upon the top of ladders in an upright position.

The Smallest One-Man Airplane

WEIGHING only 220 pounds and costing only $1200, the Pischof airplane is said to be the smallest flying-machine. It travels the aerial highway at a speed of 62 miles an hour and consumes but 11.2 gallons of gasoline an hour.

A machine of this type might appropriately be called a "runabout" of the air. It might prove of practical value to country physicians whose practice is extensive.

The small engine is a remarkable feature, while the small space taken up by the wings makes the plane easy to house.

Eye-Strain at the Movies

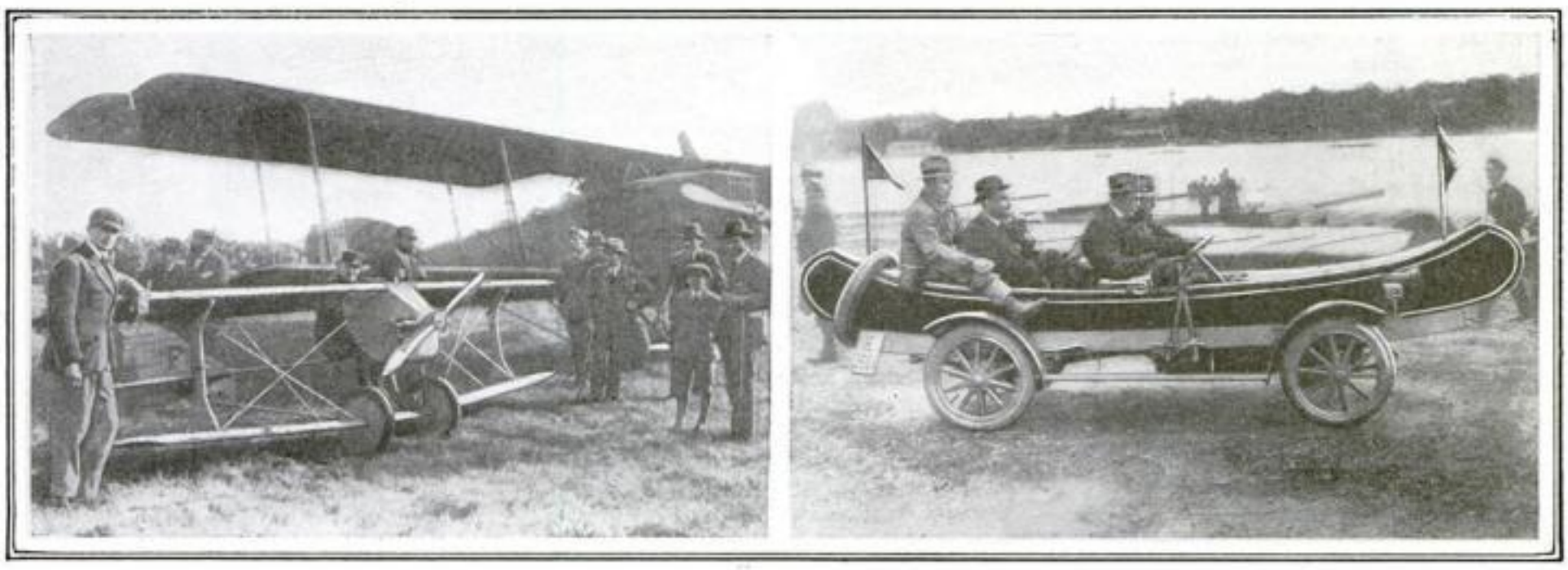
INVESTIGATION has shown that eye-strain in moving-pictures is often caused when one has to raise his head at an angle greater than thirty-five degrees to see the top of the screen. He should not have to turn his head sideways more than twenty-five degrees.

The body of the theater should have a soft, even light, approximately that given by a candle burning at a distance of forty degrees from the eye of the observer.

He Put a Canoe on a Chassis

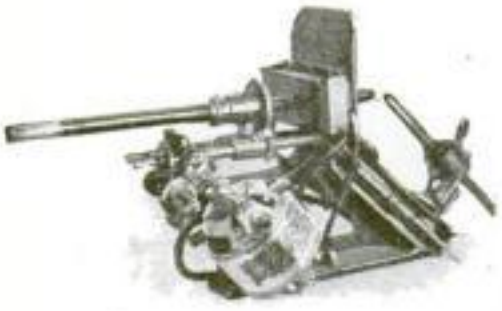
THIS is not an amphibious automobile, as you might think. It is merely an automobile chassis fitted with a canoe-body.

The owner wanted something that looked different, so he bought an old canoe and fitted it over the chassis of his car in the manner shown. He not only had a cheap body but a car that attracted attention wherever it went. A glance at the picture, however, does not speak much for the comfort of this freakish-looking apology for an automobile. Its four passengers appear to be rather crowded for space.

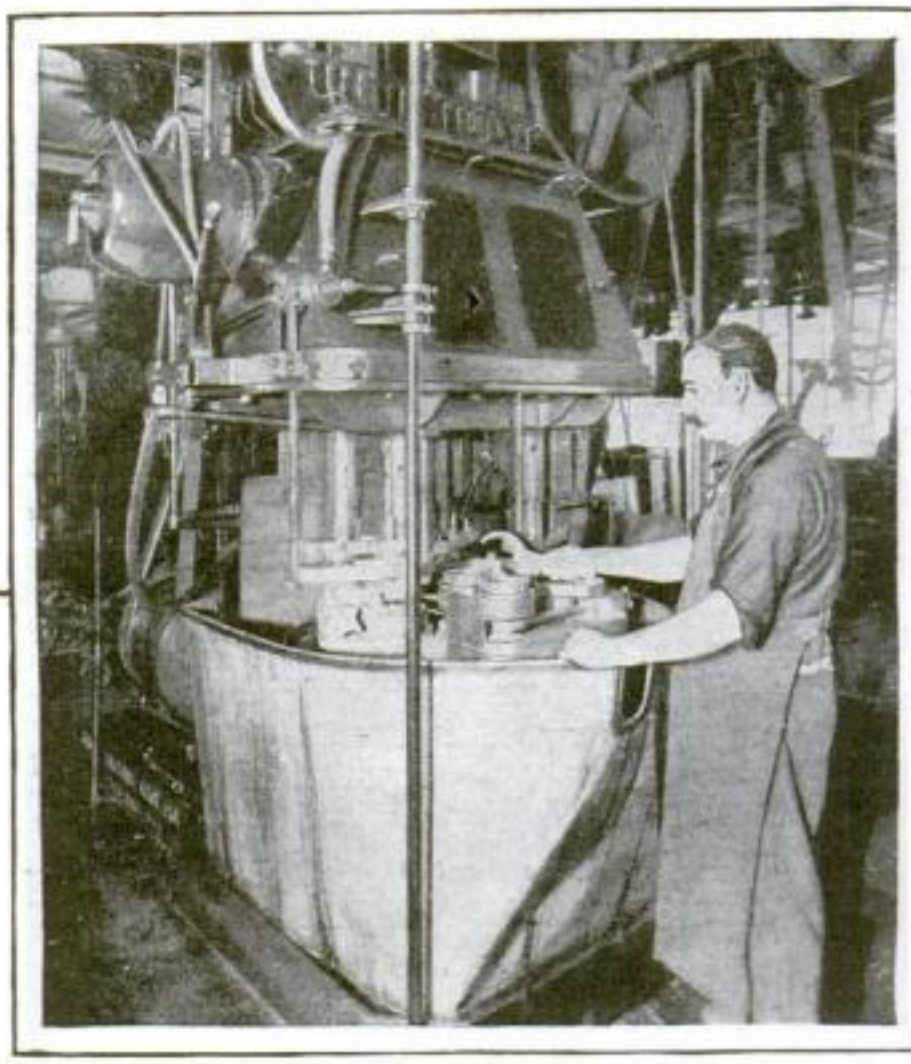


Do It with Tools and Machines

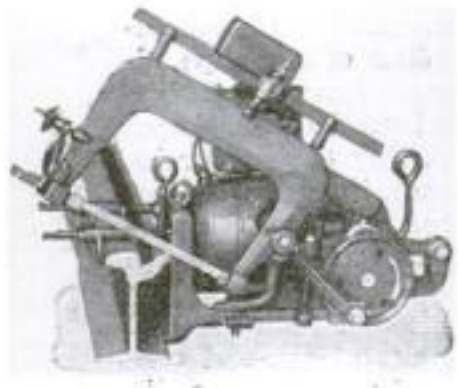
Industrial weapons forged by man's inventive mind



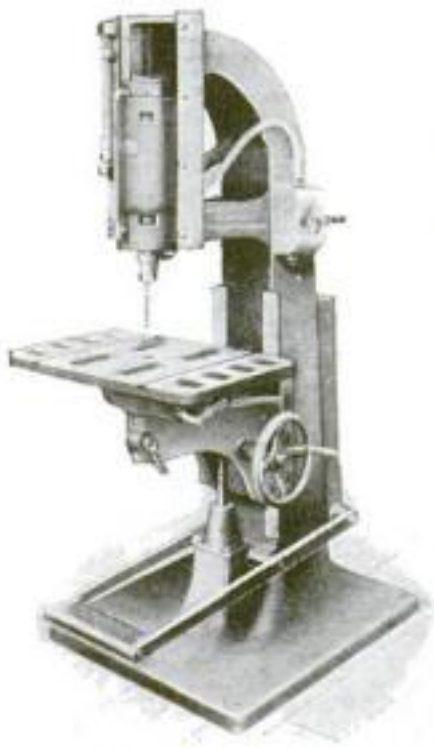
By changing the position of the carbon so that the arc leaves its crater at an angle of 120 degrees, and by rotating the carbon rod, the spotlight illuminating power is increased 40 per cent



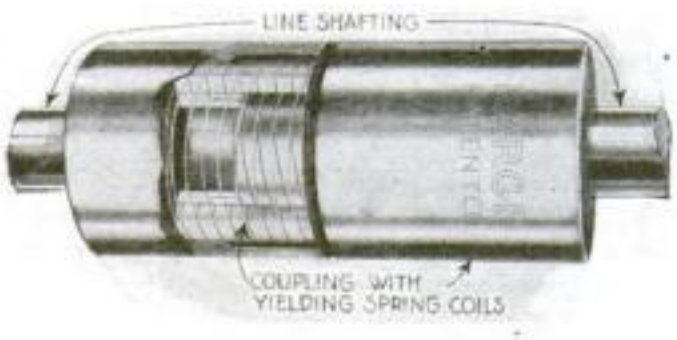
This multiple spindle drill-press is equipped with a revolving table that indexes for each successive operation of rough drilling and reaming of connecting-rods. The machine head is returned to position by air-pressure



Clamp this rail-cutting machine to the rail, adjust the saw-blade, and turn the switch of the motor; the machine will do the rest



No belt is required for this drill-press, driven by a vertically mounted motor. The drill is attached to the shaft. A treadle controls the motion



Flexible friction coil couplings make it possible to couple shafts with an offset of ⅛ inch or a deviation in alinement of 10 degrees

With a machine like this a workman can stamp the name of the manufacturer on 2500 pairs of shoes in a single day

One of the centerless cylindrical grinders will prove of great advantage in all cases in which accuracy and speed are essential

The first few teeth of this tap do the cutting, while the others act as a lead screw which removes the chips that would otherwise bruise the thread upon removal of the tap

If the side-cutting jaws of this plier become damaged they can be removed and a pair of new crucible steel jaws can be put in their place

This tool for heavy service on lathe, planer, or shaper is practically the equal of hand-forged solid tools, and is more economical

Keeping Up with the March of Science

Facts for the man who wants to know

A Tree that Meets Every Need

IN the islands of the southern seas, the coconut palm supplies all of the needs of the members of society. It supplies the natives with lumber to build their homes, their boats, and their utensils.

When the leaves of the tree are young, they are eaten. When they are old, they are woven into hats, clothes, baskets, bedding, paper, and thatch. The ribs of the older leaves are made into spears, arrows, brooms, torches, and paddles.

The flowers of the tree give the natives wine, vinegar, and sugar. The fruit of the palm yields oil, foods, cord, and matting.

It is said that even the roots are sometimes used as food.

The Scientific Koreans

AN American missionary who recently returned to this country credits the ancient Koreans with being scientists and inventors. He claims that they used iron-clad warships against the Japanese as early as 1597. They used cast type long before any other people, and they were employing gunpowder as early as 200 B.C.

Their astronomers thought out the operation of the planetary system thousands of years ago. They invented the magnetic needle and were the first people to underglaze pottery. They also introduced carpentry and architecture into Japan, and were the first to excel in the manufacture of silk.

Bronze and brass foundries were in operation in Korea at the beginning of the Christian era. It has been said that Korean engineers designed and constructed the great wall of China.

What Makes Milk White?

HAVE you noticed that some milk is white, some has a bluish cast, while cream is yellow? Milk in a normal condition contains many millions of minute spheres of fat, and these act as little mirrors, reflecting the light in all directions. The more numerous masses, as in the compact form of cream, produce an absorption of a part of the light, reflecting the yellow rays. When the masses of little spheres of fat are less numerous, as in skimmed milk, the liquid becomes more transparent, and as there is less reflection the color is bluish.

It is interesting to compare this phenomenon of light with the milk-white and the dull rings of the distant planet Saturn. Through the telescope this same principle of reflection from small bodies is apparent. The more compactly formed portion of the ring that surrounds Saturn shines with a pure white light. Here there are countless millions of little moons flying around Saturn, reflecting the sunlight as do the spheres of fat in the rich milk. As these masses become less compactly grouped on that portion of the ring farthest from and that nearest to the planet, we can see the dark sky through the ring. On its inner and outer edges it is transparent and thus appears dark.

What Is a Dollar's Life?

A DOLLAR does not go very far nowadays, but the journey it makes must be a hard one if we are to judge by the wear and tear upon the life of the average dollar.

According to a table compiled by the Treasury Department, a dollar note lives but 2.03 years, while a silver certificate stays in circulation but one year. A five-dollar note stays in service 2.49 years, a ten-dollar note 3.57 years, while a twenty-dollar bill lasts 5.94 years. A hundred-dollar note lives as long as 6.15 years, while, curiously enough, a five-hundred-dollar bill lives but 3.78 years! But this is a long time compared with the longevity of a ten-thousand-dollar note, whose period of service is actually but .16 of a year.

The notes are by no means worn out in use, but are freely retired on becoming unserviceable.

Radium Used in Pottery

WATER containing radioactive compounds is used as a curative agent for certain illnesses. Mere contact with such compounds for a sufficient length of time will make water slightly radioactive.

Pottery is now manufactured which has in it a small percentage of radioactive material. This is mixed with the clay and baked in the kiln. Water left in pottery of this nature for a short time will become radioactive by "induction," and a health-giving drink is made.

Such water may also be employed in the watering of plants with good results, since the presence of a radioactive compound near the roots of a plant is very helpful to its growth.

Do Frogs Like Music?

DID you ever wake up in the country, on a summer night, and hear the frogs saying *kerchunk?* Probably it would be more sensible to ask if you managed to get to sleep while they were croaking.

An Englishman claims that frogs can be charmed with music in much the same manner that a snake may be charmed. He tells of having held four frogs absolutely spellbound with piano music.

Science has made another great discovery, and it may be of some benefit to mankind.

Moisture X-Rays the Wall

LOOK up at the ceiling and at the wall of your room and see if you can locate the skeleton of the lathes back of the plaster. If the room is of suitable location and temperature, the phenomenon can be observed. Investigation shows that the black markings are the spaces between the lathes, just as one might look between them into the dark shadows of the attic above, or the dark background between the plaster and the outer wall. Curiously, this effect cannot be observed in interior rooms, or upon the ceiling of a lower room where the upper part of the house is kept warm.

Temperature and moisture are found to be responsible for the effect. The warm air of a room contains much moisture and also fine particles of dust. The attic is usually cold, as also is the air-space back of the plaster of the outer walls. This causes the moisture to condense on the spaces between the lathes where the temperature difference is greatest, and in condensing it deposits the particles of dust.

Making Use of Lizard Skin

THE lizards of India—and India has a great crop of them—are hunted for their skins. Women's and children's shoes, purses, and handbags are manufactured from them. These articles have been found to wear as well as calfskin or glacé kid.

The average skin is two feet square and is worth thirty-two cents. A pair of shoes made of lizard skin costs four dollars.

Why Plants Freeze to Death

FOR scientific as well as for practical reasons, the question as to the exact manner in which the death of plant life is caused by freezing is of great interest to scientists. A number of explanations of the phenomenon have been given.

Some investigators were of the opinion that the freezing or crystallization of the water contained in the cells caused a disruption of the plasma membrane, which is extremely sensitive. This theory was not accepted by others, who maintained that, the plasma being a viscous liquid, it may be assumed that the membrane would be able to yield sufficiently to avoid rupture.

Other investigators claimed that it was not the freezing, but the thawing out, especially rapid thawing, that destroyed the cells. This opinion is correct only in part. It is undoubtedly true that rapid thawing may destroy frozen cells which with gradual thawing would have survived.

The problem is greatly complicated by the fact that certain plants survive even a severe frost and revive after they have been

frozen hard and stiff for a considerable period, while other plants, especially those coming from the tropics, are killed by temperatures only slightly above the freezing-point.

A new theory assumes that the freezing removes part of the water contained in the colloidal living substance, and that the water thus separated cannot again be absorbed by the colloid. Another effect of the freezing undoubtedly is that mineral salts, sugar, and other substances contained in solution in the cells are deprived by frost of part of the water in which they are dissolved. The solution hence becomes too saturated.

Indirectly the frost injures plants if the ground is frozen hard, while the sun keeps the plants themselves below freezing temperature. The roots and rootlets, frozen hard, are unable to supply the plant with water, and the plant wilts. Severe cold may cause disruption of the cells in the interior of the plants which in some cases may cause the death of the plant by the drying up of the injured tissue. Trees are often split by extreme cold, but otherwise healthy trees are seldom permanently injured by the cracks.

Ancestors of the Big Trees

AMPLE evidence is to be had that California's great trees, the sequoias, whose first sprouts appeared above the soil at least seven centuries before the advent of our Christian era, are the survivors of a widely distributed race that millions of years ago spread over a vast area of the world. Probably more than eight million years ago these trees, the redwoods, were leaving their time-resistant cones as records which to-day are unearthed as fossils. Beneath their lofty branches giant reptiles crept or flew.

The ancestors of our sequoias towered above the ferny underbrush that preceded modern plant life. There were no flowering plants in those days; they developed later, and are the food sources of civilized man. In the shade of the great trees the giant reptiles came and vanished, the little five-toed horse developed into the modern horse. The race of trees survived and watched the evolution of the whole animal species up to the age of man. What a remarkable history the redwoods could tell of life on our planet!

Watch New York Grow

THE 1920 Census Report shows that New York city has within its limits 5,620,048 inhabitants. This means that in the past ten years 853,166 strangers have come to the city to live—a rate of more than 85,000 a year.

This increase, averaging more than 17,000 families of five to the family, means that 142 apartment buildings, housing 120 families, would have to be built each year to house all these newcomers. This has not been done, hence the serious lack of housing that threatens the great city.

In New York state there are now 10,384,-144 people, an increase of 1,270,530 since 1910. It can be seen that New York city has gained practically two thirds of this increase in the state's population.

Cement Joints for Iron Pipes

LEAD is usually employed to make joints in cast-iron water-pipes. Lead has recently been replaced and cement has been brought into use as a substitute.

This experiment was conducted by a water company of San Francisco, California, and it is claimed that a great saving has resulted. The cement can be rammed in place much more easily than the lead and considerable reduction in cost is effected.

Animals that Glow

AMONG the interesting phenomena of organic life is the luminescence or phosphorescence of certain animals and plants. The light-giving power of so-called lightning-bugs, of certain organs characteristic of deep-sea fishes, of certain micro-organisms that cause the phosphorescence of the sea in tropical and sub-tropical latitudes and of decaying wood belong in this class.

It was originally believed that the glowing and decaying wood was caused by some chemical process of decay; but recently investigators, among them Brefeld and Molisch, ascertained that the mycelium of certain fungi of a low order produces the phosphorescence, and the decaying wood is concerned in the process only to the extent of supplying the nutriment for the development of the mycelium.

The exact process of light production has not yet been ascertained, but it is known that only in the presence of free oxygen is the phosphorescence at all possible.

According to the theory advanced by Molisch, the cells of the mycelium produce a substance that he calls photogen and that gives light in the presence of water and free oxygen.

Saturn without Its Ring

THE man in the street may notice the planet that some one has pointed out to him as Saturn. He has heard of the remarkable flat ring that surrounds this distant world. If he takes a look through a telescope any time until February 22, expecting to see the ring, he will be disappointed. On November 7 the earth passed through the plane of Saturn's ring, and now we are on the unilluminated side of it and can see only its dark shadow where the ring crosses the ball of the planet.

It takes Saturn almost thirty years to make a trip around the sun, and twice in that interval the earth passes through the plane of the ring. The event is of much interest in attempts to solve some of the problems concerning its structure. With a large telescope a very thin bright line can be discerned at the time the ring is exactly edgewise toward us.

The Pale Eyes of City People

PROLONGED absence of sunlight tends to produce pale hair and colorless eyes. Both vegetable and animal coloration depend to a proportional degree upon direct sunlight. Note the albino fish of caves, the white shoots of plants eternally shielded from the sun. In like manner the eyes of a human being would become less rich in color, as also would the skin and hair, if he lived constantly in deep shadow.

Based upon this theory, one might expect the dwellers of city apartment-houses eventually to develop these characteristics to a degree. A French professor has told the Academy of Sciences in Paris that after long residence in the city an individual's eyes grow paler and the hair undergoes bleaching. Dark eyes are less sensitive to light than pale ones; hence the dark-eyed people of the sunlit tropics are better able to endure the stronger light without pain.

The Life of a Star

IF we examine the light of a number of stars, some will be found to be white, others yellow, and still others red.

In certain white stars hydrogen and helium gases are conspicuous, and there is little indication of metallic elements. These are the youngest suns of the universe. In another kind the helium is less pronounced and the hydrogen is strong, while the metals have made their appearance. In still another kind, such as the sun, the metallic elements, such as iron and titanium, are present in the atmosphere of the star.

At last we come to the kind of star that shines with a red glow, and whose atmosphere contains metallic compounds, oxides of metals, and cyanoger

There are many reasons for supposing that a star is formed through the condensation of primitive matter diffused throughout space. Compactly forming under gravity, there are frictional shocks and collisions that greatly raise the temperature of the mass. The star grows hotter as it becomes more compact until the heat produced becomes less than that radiated away through space. Then the star begins to cool until it finally becomes extinct and dark.

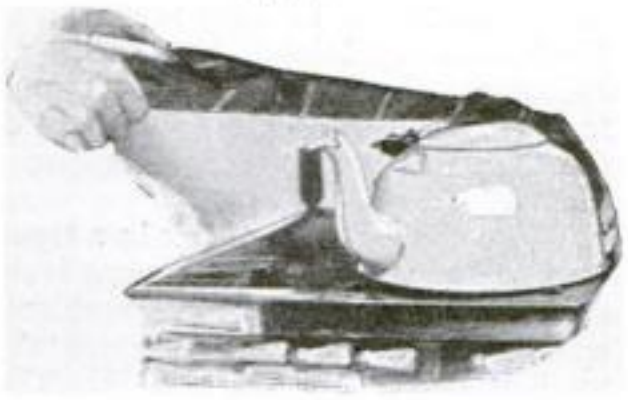
Buying Scientifically

THE engineer or architect must be continually on the lookout for errors arising from the use of unstandardized material. His specifications may permit the use of several kinds of lumber, but he is at a disadvantage because he has no means of knowing from what region the wood will be secured, and therefore what sizes will be supplied.

This frequently is the cause of discrepancies and inaccuracies in his design. The technical man becomes familiar with grades "X, Y, and Z" of a certain species of lumber. There comes a time when he is unable to secure that species and has to use the same named grade of some other kind of lumber. This he may find totally dissimilar and unsuitable.

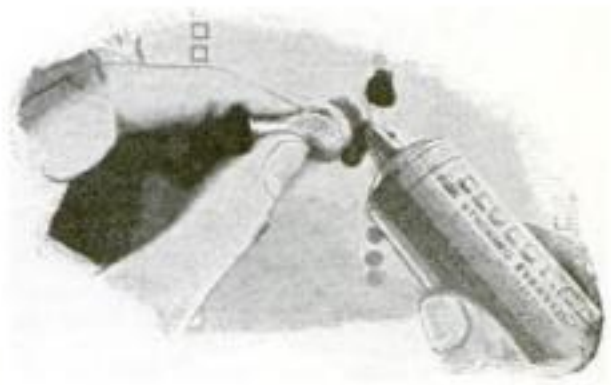
There should be a national instead of a regional standardization of sizes and grades of lumber. It would result in greater efficiency in distribution and use, reducing the cost of labor in handling and simplifying the lumber-dealers' multiplicity of stock items.

Housekeeping Made Easy



Here is a wooden tie-stretcher—two arms hinged at one end. You slip it into the tie, spread the arms, and hold it over steam

This is the new electric floor-polisher. A small motor revolves at the rate of one hundred and sixty revolutions a minute and carries with it a circular brush



What can you do when a nail-hole outgrows the nail? Wrap some cotton around the nail and soak it in glue. Then put the nail back

Need some new saucepans? Buy, instead, a detachable handle and adjust it to an old can. In this fashion you will have as many saucepans as you have cans

One of the best things a spool does is to roll. But this new holder attached to a safety-pin enables you to fasten the spool to your dress while you sew

How can you prevent a box of cigars from going dry? By placing a small water-soaked porcelain block inside the box. This white block is encased in rubber

To prevent a glass utensil from cracking when boiling liquid is poured in, slip a steel knife under it

Hang your ironing-board on the door. There is a metal holder with hinged arms that can be adjusted to fit any ironing-board

Don't wrap a cloth around a hot dish when you wish to carry it to the table. Rather, place the dish in a wire frame like the one above, and protect both dish and table

She lowers the mop into the wire basket, slips the half ring over the mop-handle, and pulls the handle forward, squeezing out the water

The scoop of the body is pushed back by the truck into the material to be loaded and the load is automatically taken aboard

A Motor-Truck Body that Loads Itself

SOMETHING new in the way of self-loading motor-truck bodies has recently been invented by Frederick Wengraf.

The body of the truck is mounted on rollers, which run in special tracks on the truck chassis frame and permit the body to be pulled backward off the chassis on to the ground by means of a cable and drum operated from power taken from the regular truck engine. The rear end of the rollers curves down so that the body is lowered gradually.

When on the ground, the body is pushed backward into the bulk material to be loaded by backing up the truck chassis. The body tailgate, which is pivoted at the bottom, is automatically controlled by a separate drum and cable so that it can be swung downward to act as a scoop.

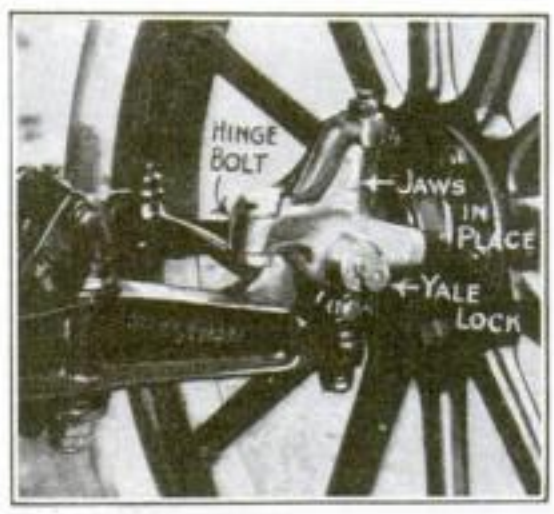
The body may be entirely disconnected from the chassis in thirty seconds.

Handcuffing a Car to Prevent Theft

AUTOMOBILE thieves have been more and more reckless in the past year or so. Among the many devices that have been invented to combat their depredations, one of the most effective is a veritable handcuff which is fitted around the vertical pin of the steering knuckle and locked in place so that the front wheels can turn neither to the left nor to the right.

The apparatus consists of two hinged steel jaws with wedge teeth. A double-headed bolt operated by a special lock holds the jaws in place, thus making the steering knuckle rigid. The entire mechanism can be carried in the coat pocket when not in use and can be locked to the steering-wheel or taken off in a few seconds.

One advantage of the lock is that it conforms to all city ordinances in that its use does not make the car immovable, which would constitute a danger in cities in case of fire, but permits it to be moved in a straight line either forward or backward. The front wheels, however, cannot be turned so long as the lock remains in place.



When this lock is snapped on the wheel, the car can be run only in a straight line

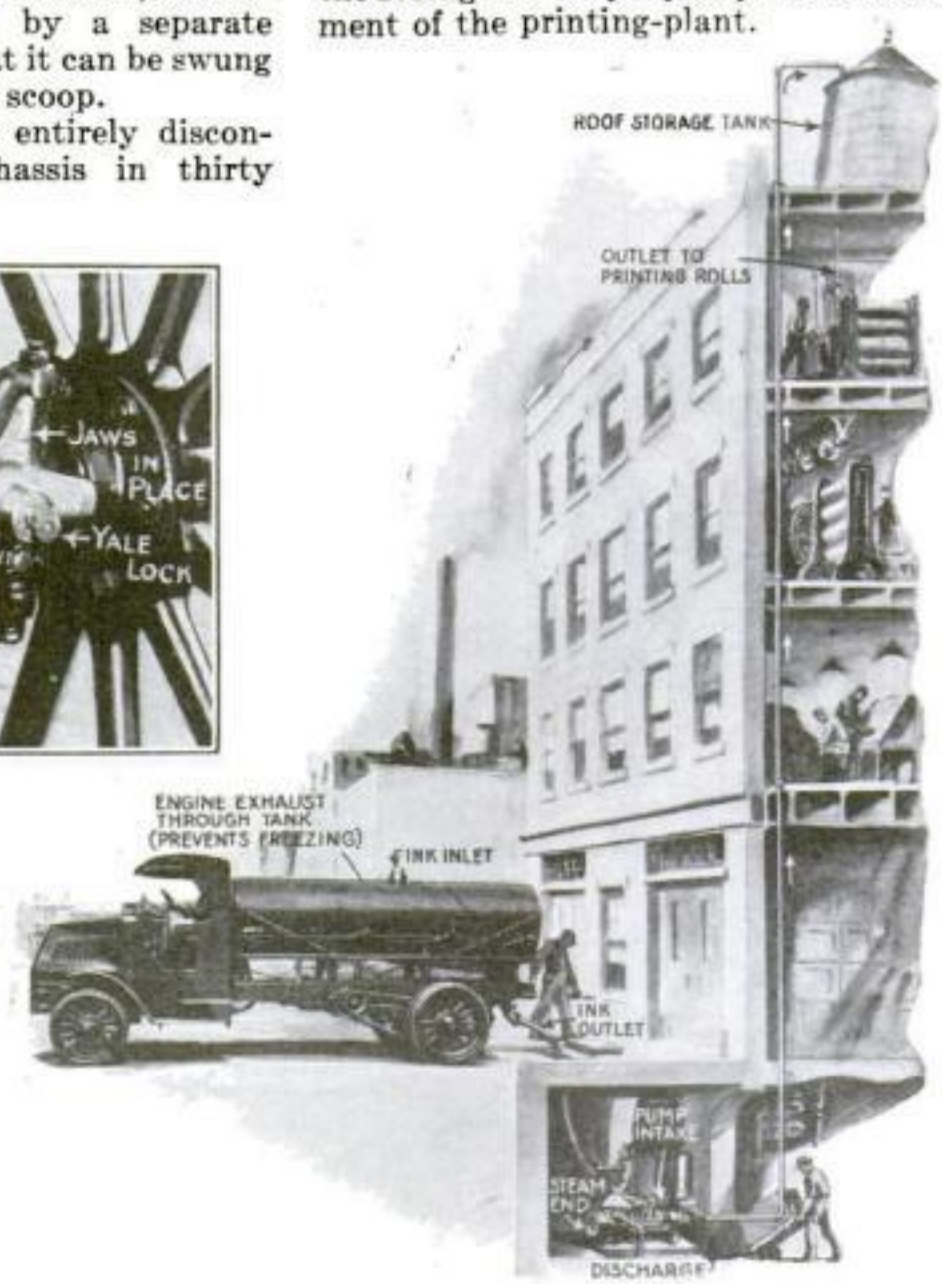
Motor-Truck Tanks Deliver Printer's Ink

THE first truck to be employed in carrying ink in bulk is shown in the illustration below. It is used by a Hoboken, New Jersey, ink manufacturer to deliver ink to several of the New York city daily newspaper plants.

While the carrying of ink in a truck tank at first would seem comparatively simple, it presented two problems which had to be solved before the method was made practicable. The first of these was to prevent the ink from freezing in cold weather. This was solved by running the exhaust pipe from the truck engine through the bottom of the ink-tank.

The second problem was to get the ink from the truck tank to the storage tank usually placed on the roof of the printing-plant. When the ink was delivered in barrels these were raised to the roof in the freight elevator. But with the ink delivered in bulk in 750-gallon lots, the use of barrels for unloading was impracticable. A new method had to be devised, and so a filler pipe was run from the roof tank to the sidewalk.

The ink is allowed to run into this pipe by gravity and is then lifted to the storage tank by a pump in the basement of the printing-plant.



Printer's ink is delivered in bulk by this tank-truck. The ink is discharged by gravity and pumped from cellar to roof

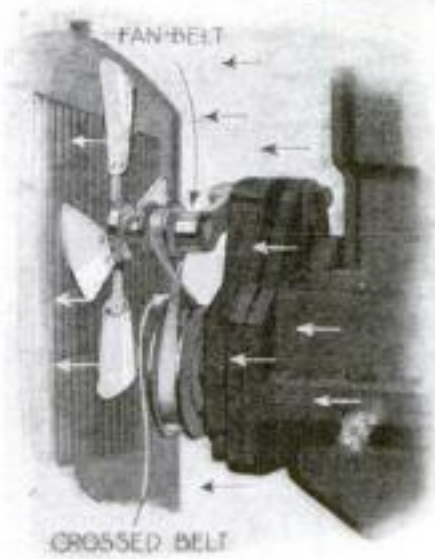
In an Emergency This Is a "Hot One"

IF, while using your automobile on a very cold night, you discovered that, during a short stop which you were obliged to make, your radiator had become "froze up," what could you do to thaw it out so that you could safely run the engine and get home?

This was the problem which the writer encountered recently, and its solution again proves that "necessity is the mother of invention."

After considering a number of impracticable and more or less wild possibilities, the logical conclusion was that the engine must furnish the heat wanted. This in turn led to the "big idea" of driving the cooling fan in a reverse direction and thus making it a *heating fan*. The idea was quickly carried out by first slacking the fan-belt and then crossing it to give a reverse drive to the fan.

In less than ten minutes the radiator was thawed and water circulation resumed; the belt was then replaced in its normal position —and "Home, James," was again possible.



By reversing the fan the warm air from the engine is blown against the radiator, thawing it out

If you live in an apartment on wheels, moving loses its terror and becomes a pleasant diversion, a source of delight at all times

Traveling with a Furnished Apartment

HOW would you like to have a suite of rooms on wheels, so that, if you wished to take a long trip, you would be able to take your hotel accommodations along with you? That, in effect, is what a Mid-Westerner proposes to do. He has had built for him a motor-truck and trailer combination that has all the comforts of a stationary home—and with almost as much actual room in it as many a modern city apartment.

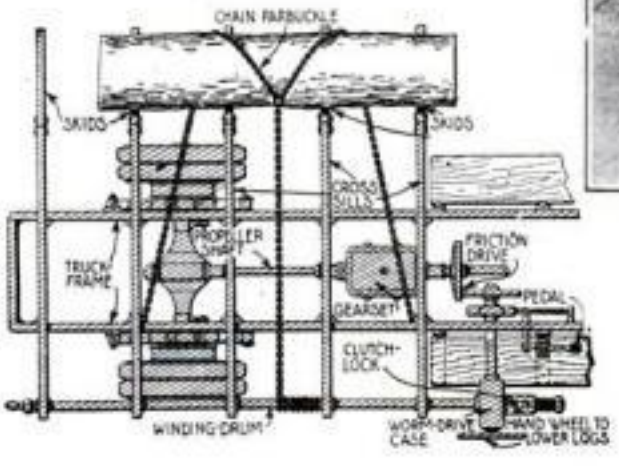
On the motor-truck he has had constructed a "living-room," which also does duty as a dining-room. The trailer carries the sleeping-room and bathroom. Between the living-room and bedroom of his traveling "apartment" he has a passageway, somewhat after the design of Pullman-car telescoping vestibules. It would be quite possible for a large motor-truck to tow two or more trailers, each carrying one room, connected by flexible vestibules.

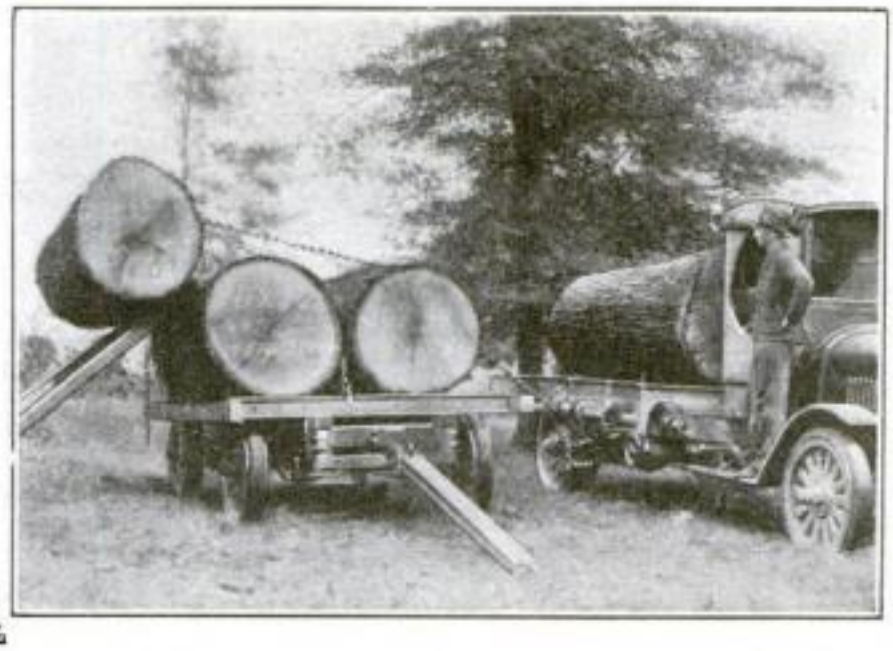
A New Logging-Truck Loads Itself and Trailer

A LOADING mechanism has recently been placed on the market which may be applied to any make of motor-truck. The apparatus is particularly adapted to loading big logs on motor-trucks or trailers. Furthermore, the same mechanism may be used to pull the logs from the place where they are cut to length to the side of the truck or trailer on which they are to be loaded.

The entire apparatus is operated by the truck-driver simply throwing in a clutch and pressing down a pedal, the power being secured from the ordinary propelling engine of the motor-truck on which the apparatus is mounted. The size or the shape of the logs do not affect the work of the machine. Logs may be loaded from either side of the truck. In addition, other unwieldy objects required at a lumber-camp can be handled equally well.

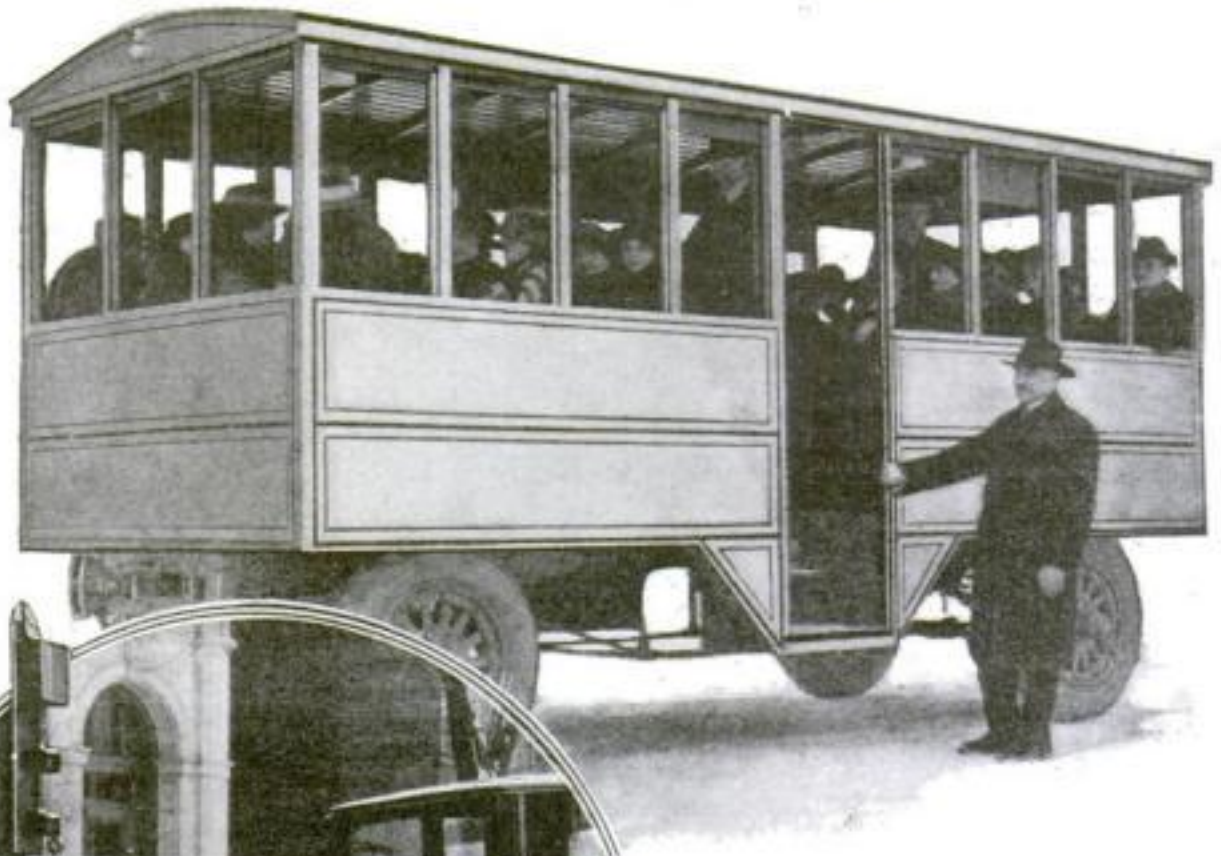
The apparatus consists of a framework for supporting the logs; a winding-drum and a mechanism for turning the drum by means of power taken from the truck engine. The supporting framework takes the place of the ordinary truck body and consists of four I-beam sills set equally distant crosswise of the truck frame at the back of the driver's seat. The winding-drum is mounted on a shaft carried at the ends of the cross sills and parallel to the centerline of the truck chassis. The power is transmitted from a driving friction disk on the shaft to a driven disk at right angles to it.





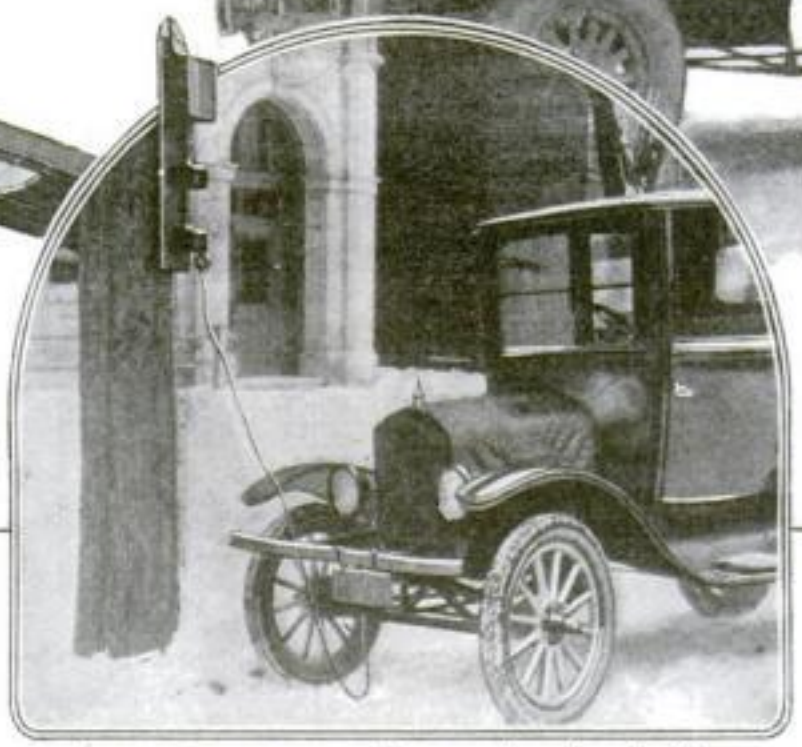
Logs of any size can be loaded on the truck or its trailers by utilizing the power of the driving engine of the motor-truck. The diagram on the left shows the detail of the arrangement of the mechanism which is controlled by the driver. The logs are hauled by a chain which is wound on a drum

New and Practical Accessories for the Passenger Automobile and the Truck



Bus-trailers help to solve the passenger-transportation problem. The bus shown here has reversible and rattan-covered seats for thirty persons, and is arranged similarly to a street-car, with doors at the side

This lubricator, which is made in the shape of a tomahawk, can be forced between the leaves of the automobile spring by a few taps with the hammer. It feeds the grease from a hollow handle



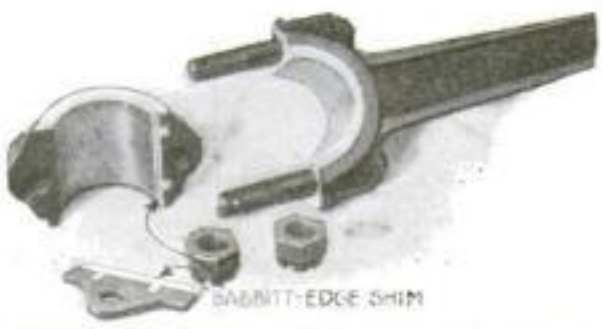
By paying an annual fee to the electric-light company of London, Ontario, you obtain the right to tap the electric current at any of the plugs installed at numerous points, for heating your radiator in cold weather

In one of the new models of a certain American car the bow supports of the top at the rear corners are removable. They are carried in the tool-box when the top is up

Nuts, bolts, or tools accidentally dropped into the drip-pan of the engine are easily recovered without loss of time by means of a magnet attached to a wooden handle

With this extension wrench-handle, nuts in places reached with difficulty may be turned with any flat or S wrench without resorting to a makeshift

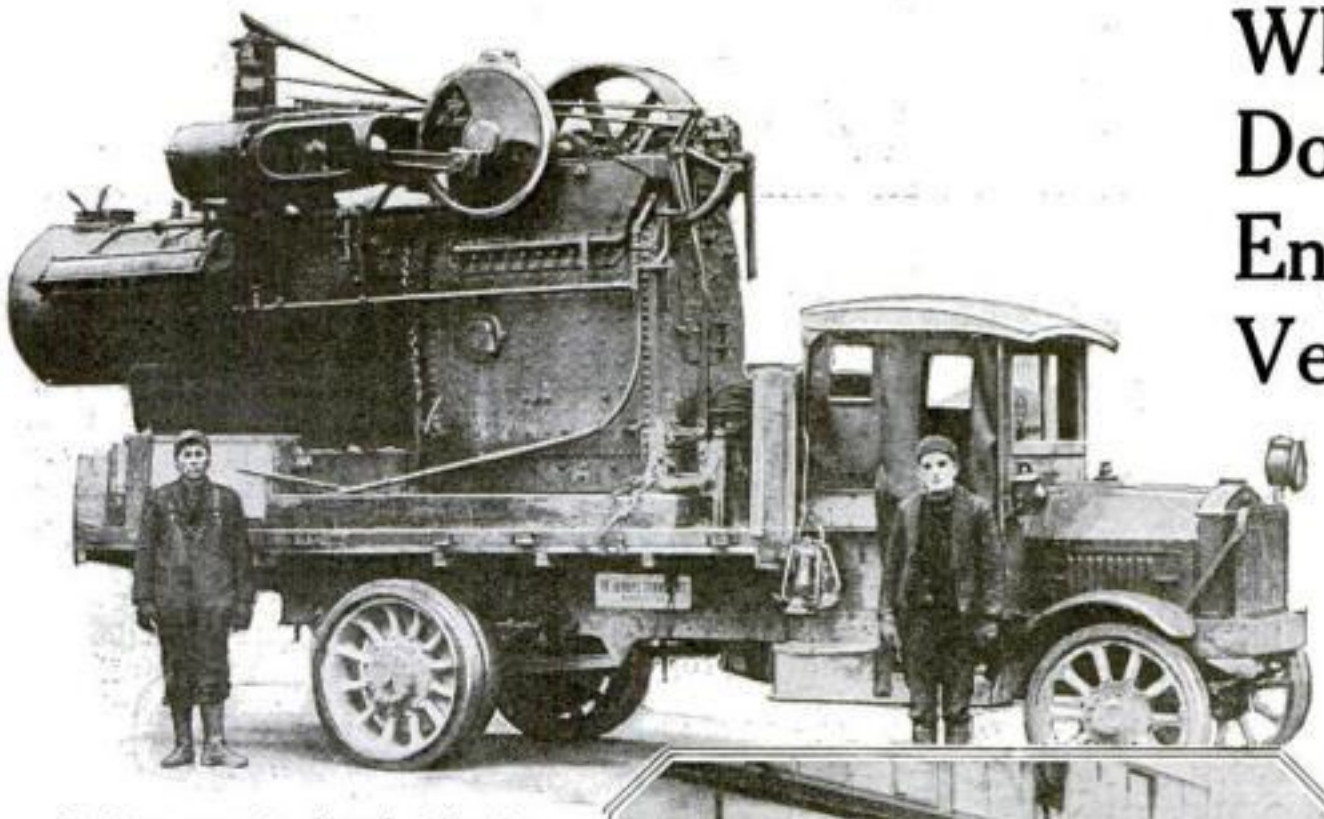
Carbon scrapers may be used to advantage for fastening or unfastening screws in places inaccessible to straight screwdrivers. The scrapers are made of the best materials and will stand hard wear



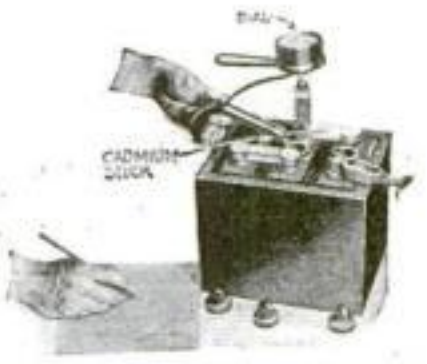
Babbitt-faced shims for automotive bearings are among the most recent improvements. The shims are locked in the manner shown to the brass part of the shims

Instead of crawling under your car to oil the springs, take a spray-gun filled with kerosene and a little powdered graphite and spray the mixture between the leaves. The kerosene will carry the lubricant

What Inventors Are Doing to Improve Engine-Driven Road Vehicles of All Kinds

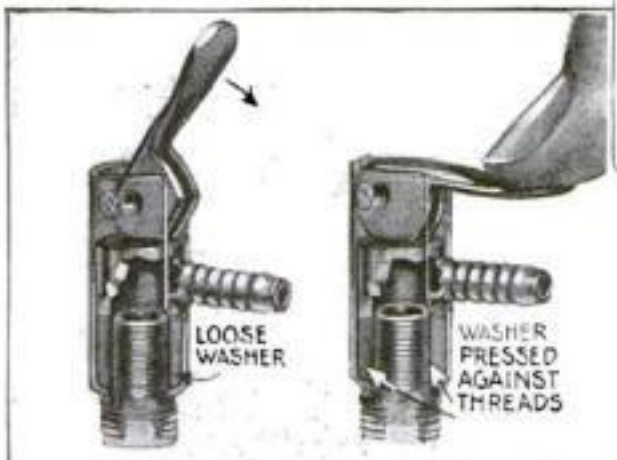


During a recent railroad strike the eight-ton combination boiler and engine shown here could not be moved by rail. It was loaded on a truck and carried from Dunkirk to Toledo, Ohio, a distance of seventy miles, without mishap

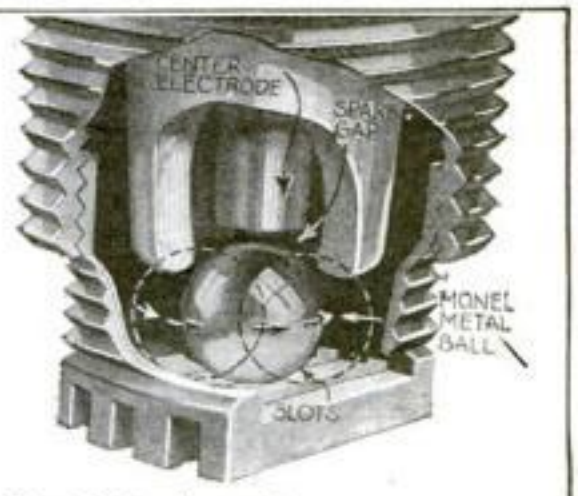


This apparatus indicates the voltage of your storage battery on charge or discharge and the state of efficiency of any plate in the battery

What is believed to be the smallest high-power automobile ever built is shown in the foreground of this picture. It has shown a speed of fifty-eight miles an hour, is a wonderful hill-climber, and is equipped with a two-speed transmission and a six and a half-gallon gas-tank

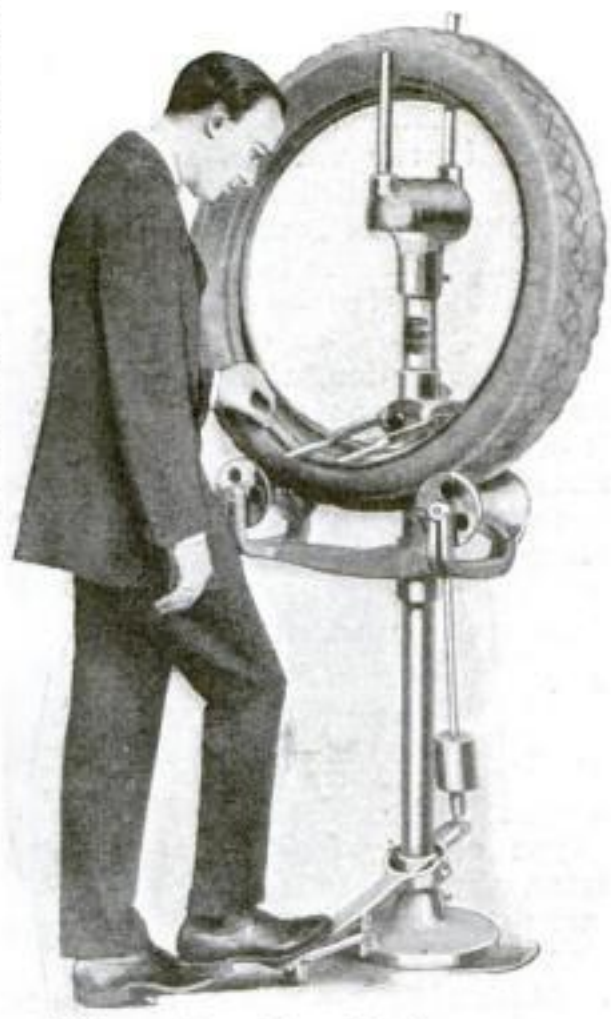


By pushing down the small thumb lever, the rubber washer is pressed against the thread of the tire valve and air leakage prevented when the tire is being inflated



In this self-cleaning and self-cooling spark-plug a monel-metal ball, kept in constant motion by the vibration of the engine, prevents excessive carbon deposits

By turning the eccentric lathe of this attachment with your finger you will lock your hood so securely that it will not rattle. The tension spring is adjustable



This machine will enable the operator to inspect an automobile tire in a few moments. A powerful electric light discloses any picked-up nails or small breaks or cuts in the tire

Dust-laden air drawn into the engine will soon wear out all moving parts. The apparatus shown here removes the dust from the air on to a wet sponge

Desiring to give to his automobile a distinctive appearance, one owner of a sporting model cut the side windshields and ventilators of his car as shown here

If you wish to keep the springs of your automobile well oiled, always place an old piece of felt soaked in oil between the springs and the guiding seat on top of the springs

This small automobile is not a toy for children but a racer capable of traveling at one hundred miles an hour

The Seven-Foot Automobile

THE "Flying Peanut" is the nickname given to what is said to be the smallest practicable automobile. Seven feet long over all, it is hardly a foot and a half longer than the average man is tall. Yet it is so well proportioned that it would be difficult to distinguish it in a picture from a full-fledged racing-car were it not for the comparison in size of the car and its driver. It is owned by Robert Breese, of Long Island, who is seen driving it in the accompanying illustration.

In its design the miniature machine follows up-to-date racing-car engineering, except that like the early racers, the power of the engine is transmitted to the rear wheels by chains at the side instead of by a shaft. Otherwise the radiator, engine-hood, springs, wheels, tires, and body are built in proportion. The wheels are small and give the car a low center of weight so that it is able to make sharp turns at a high speed. The engine is a modified airplane model, said to be able to propel the car at one hundred miles an hour.

Because of the clever proportioning of its parts, the baby racer is most pleasing to the eye. The driver's seat is comfortable, and his eyes are protected by a miniature hinged windshield.

How Your Carburetors Waste Millions

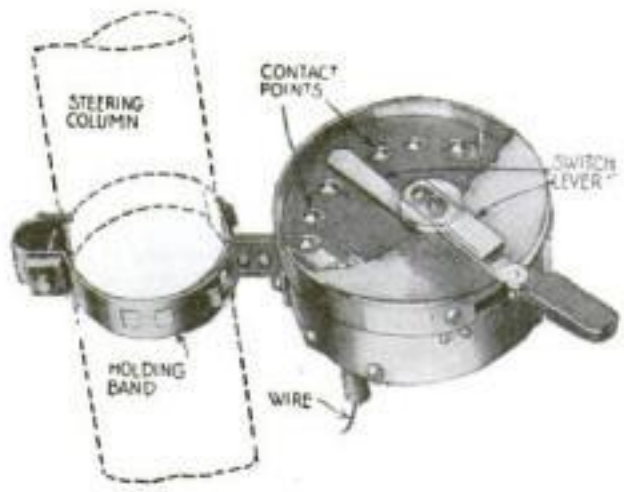
DURING a series of tests undertaken for the purpose of ascertaining the volume of carbon monoxide discharged from the exhaust of running-trucks and pleasure automobiles under average working conditions, Dr. A. C. Fieldner, supervising chemist of the United States Bureau of Mines Experiment Station at Pittsburgh, found that 30 per cent of the gasoline now used by automobiles in the United States is wasted through improper adjustment of the carburetors, causing incomplete combustion. Estimating the average price of gasoline at 34 cents a gallon, American automobilists waste annually more than $231,200,000 for gasoline.

Regulating the Headlight Glare

WHILE most engineers have attacked the problem of eliminating automobile headlight glare by the use of some form of diffusing lens, Mr. A. A. Tirrill, of Pittsburgh, Pennsylvania, solved the problem by an automatic regulator of the current strength or intensity.

The regulator consists of a rheostat mounted in a cylindrical casing directly beneath the steering-wheel. Its contact switch may be moved from one notch to another by the driver's little finger without removing his hand from the steering-wheel. The apparatus affords eight degrees of intensity between the standing light and the maximum penetrating driving-beam.

The installation of this regulator does not interfere with the lighting system of the average car. Clear lenses and polished reflectors are used with the lights so tilted that no part of the projected beam extends above the level of the lamps.



The rheostat switch that graduates your lights from the steering-wheel

The cover of the casing housing the rheostat is provided with a flexible stop, which is adjustable so that it can be set at the highest no-glare position allowed by various local authorities. The flexible stop may also be lifted, permitting the rheostat contact handle to be moved down to the standing dim position.

A New Fuel-Feed System for Automobiles

DESIGNED to overcome the temperamental non-functioning periods of the vacuum systems fitted on most automobiles, the new system here shown uses the compression in the engine cylinders to feed the gasoline from the tank to the carburetor. Whereas in the vacuum system the least fuel is supplied when the engine requires the most, the new system supplies the most fuel under the same conditions. Because of its positive action, the new system does not permit of a condition of exhausted gasoline supply when climbing steep hills as long as there is gasoline in the main tank.

The fuel feeder consists of a small cylindrical tank placed under the engine-hood as shown in the picture. It can be mounted on any make or type of car, truck, tractor, airplane, or stationary engine. There are no complicated valve mechanisms to get out of order.

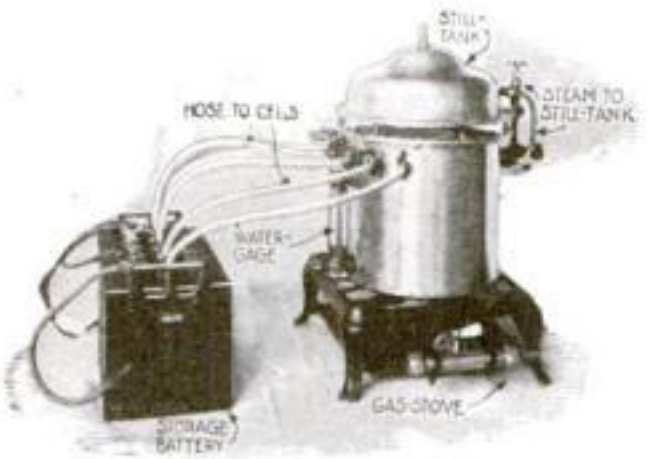
When the engine turns over, the compression in the engine cylinder to which the feeder is attached is conducted through the piping at the left to a control valve inside the feeder-tank. It then passes down into a cylinder directly below the valve, forcing down a piston in that cylinder. This expels the air below the piston through a spring-controlled valve in the bottom of the cylinder. As the piston in the engine travels downward, the pressure on top of the piston in the feeder cylinder is relieved, and the spring beneath it forces it upward, causing a suction below the piston which draws fuel from the storage-tank through the pipe at the right and top into the lower portion of the feeder-cylinder. As the engine piston again rises and puts pressure on top of the feeder-cylinder piston, the gasoline below it is forced into the feeder-tank, from which it flows into the carburetor by gravity. The piston in the pump continues to operate until the float rises and automatically closes the control valve.

The harder the engine works the more fuel it requires and the more will be supplied to it by this new feeding system

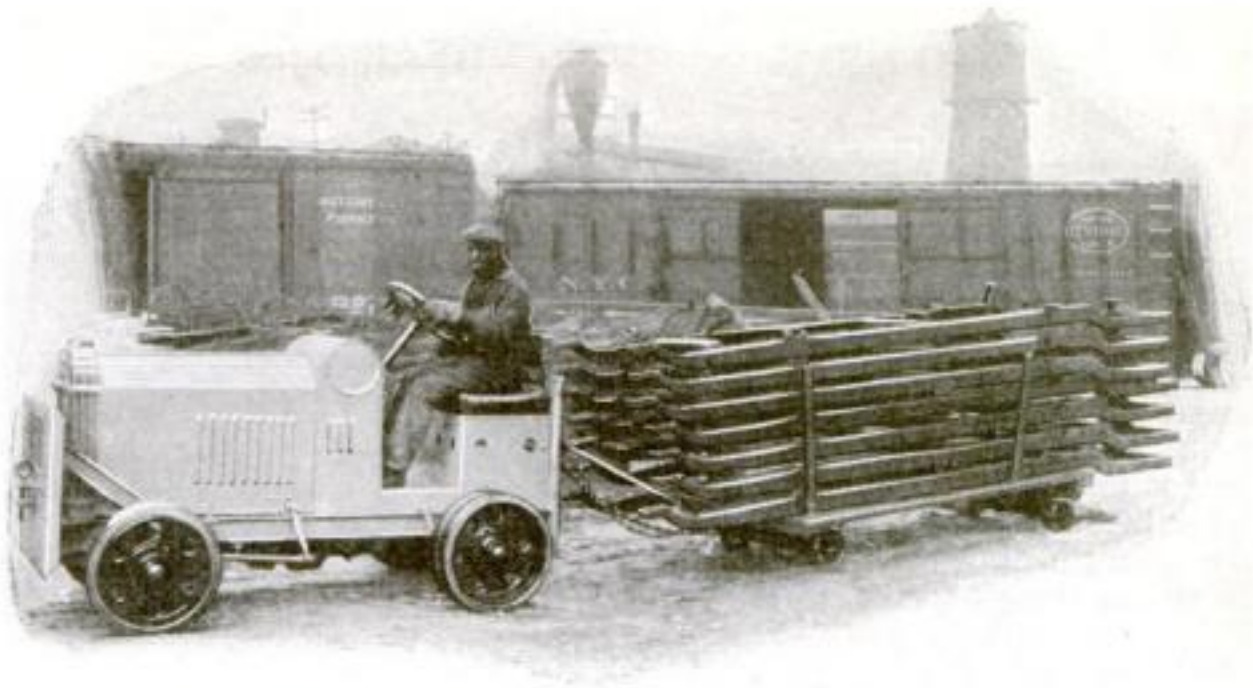
Opening Automobile Batteries Mechanically

THE putty-knife and the old-fashioned hot-water tank, when used to open the cells of an automobile storage battery, are expensive in time, money, and labor to the battery repairman and his customer. If only one cell needs to be opened, all have to be opened when the old hot-water-tank method is employed. But with the new battery steamer shown in the accompanying picture, one cell at a time or four cells together may be opened mechanically in much less time and at much less expense.

In smaller shops, where it would be a waste of fuel to keep the steamer hot all day, it may be put to a dual purpose in that the water ordinarily turned into steam for softening the battery seals may be passed through the upper of the two tanks shown and distilled for use in the battery after the cell-repair work has been completed. This combination steamer and still is heated on an ordinary gas-stove.



With this new steamer one or four cells of a storage battery can be opened



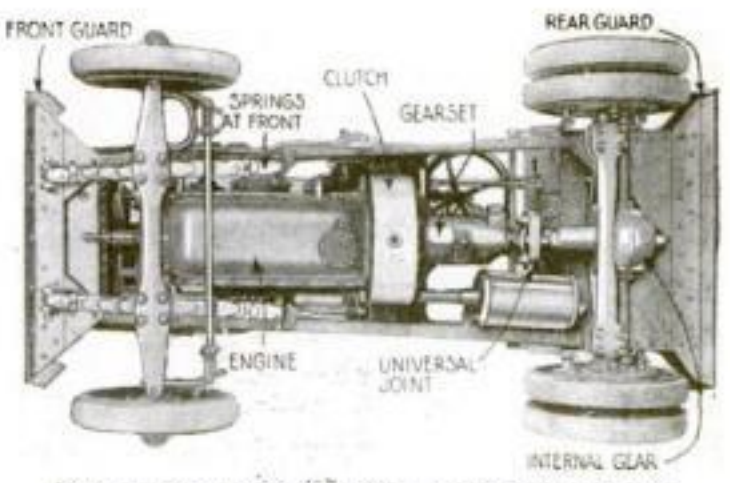
An industrial tractor that can push as well as pull load-carrying vehicles around plants, its pulling capacity being fifteen tons

This Gasoline Tractor Pulls or Pushes

ABILITY to push as well as pull, and to run twenty-four hours a day if necessary, distinguishes this new industrial tractor from other forms.

The machine will tow or push standard trucks or load-carrying vehicles or skids about plants, and do the work more quickly and cheaply than it can be done by manual power.

It is a compact four-wheeled, solid rubber-tired vehicle with a power plant, clutch, gearset, and rear axle such as are used in small-capacity motor-trucks. Perhaps the most unusual feature of the vehicle's appearance is the two flat steel bumper plates front and rear to permit pushing from either end. The machine's 22.5-horsepower gasoline engine will drive it at speeds up to fifteen miles an hour, and permit it to pull trailing loads of fifteen tons.



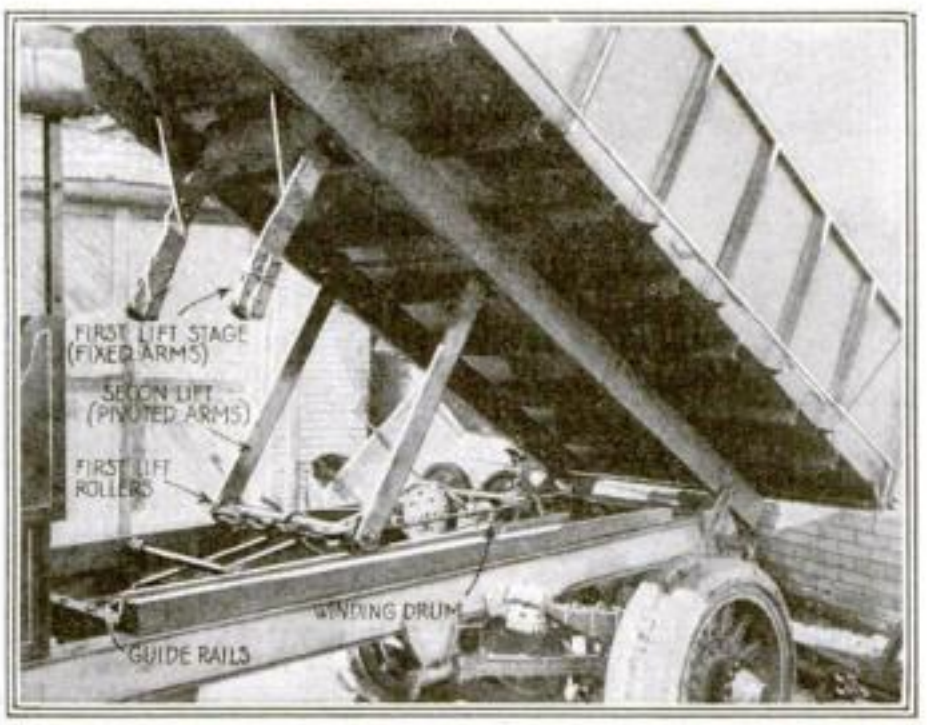
It has the apparatus of a small motor-truck. Notice the front and rear bumper plates

A New Double-Lift Hoist for Motor-Truck Bodies

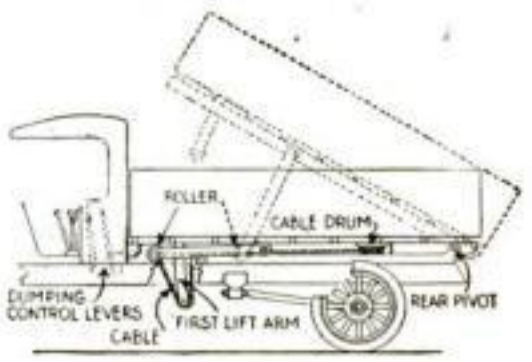
ONE of the newest mechanical hoists differs from others of the same type in that the body is lifted in two distinct operations instead of one. This method, while adding to the parts forming the hoist, serves better to distribute the lifting strains and makes it possible to raise the body to a greater angle.

The hoist is made to fit any make of truck from one to ten tons capacity. The one-ton hoist with a special frame extension is for Ford trucks and is operated by hand, while all the other sizes are mechanically operated by power from the regular engine.

The first lifting operation is by means of two vertical lifting arms bolted to the under side of the truck body near the front. These arms are raised by two wire cables wound around two drums at the rear end of the body. After the latter has been raised for one third of its height, the bottoms of the two lift arms come level with the top of the truck frame and leave the wire cables. The second lifting operation begins at this point, when two pivoted side arms, with rollers at their lower extremities, take the load on rails along the tops of the body sills and force the body up to its full height. When lifted to its highest point, the body is held until lowered by an automatic power cut-out, which disengages the driving clutches working the two cable drums. The body can be stopped at any desired point between the lowest and highest points by a clutch and hand-brake lever.



By lifting the truck body in two distinct operations this new mechanical hoist secures a greater dumping angle



Where Water Takes the Place of Dynamite

WATER is not an explosive in the usual sense of the term. Any gas or liquid will explode if it is cramped into a small space under high pressure. Compressed-air tanks often explode when the pressure reaches a high point. Water is made to "explode" by placing it under a pressure of several thousand pounds to the square inch.

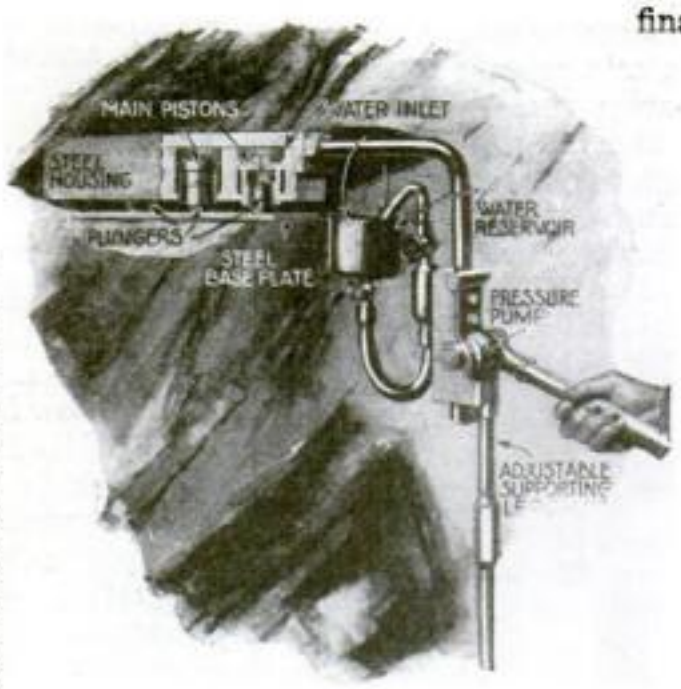
There has always been a need of a way to tear apart stone masses without using blasting-powder and dynamite. "Why not use water under high pressure?" some one asked. The idea was put to test and found practical.

This method can be used for razing buildings, quarrying, coal-mining, potash-mining, tunneling, etc. No noise is produced and there is absolutely no danger of accident or fire. The hazard of having large quantities of high explosives on hand disappears.

The "exploding" machine is really a small but powerful pump that is used in conjunction with a compressed-air drill. A hole is drilled to accommodate the expanding member of the exploding device. This part of the machine consists of a steel housing provided with a number of cylinders and pistons. Water is forced into these cylinders with a small hand-operated water-pump. After the water-pump is operated for a few minutes the pistons exert a tremendous pressure upward and downward. The material in which the device is inserted is fractured; finally it gives way to the pressure.

One man is able to exert a terrific pressure with this simple device. A pressure of many tons per square inch can be brought to bear if the small water-pump is operated long enough. A battery of these machines will make short work of a brick building if it is to be torn down. One illustration shows men at work "forcing" down a heavy brick wall.

Water taking the place of dynamite in razing a brick foundation with a battery of small hydraulic pumps



The "exploding" machine is a powerful pump used in conjunction with a compressed-air drill. The pump, operated by hand, forces the water into cylinders, bringing a tremendous pressure to bear and resulting in an explosion like that of dynamite

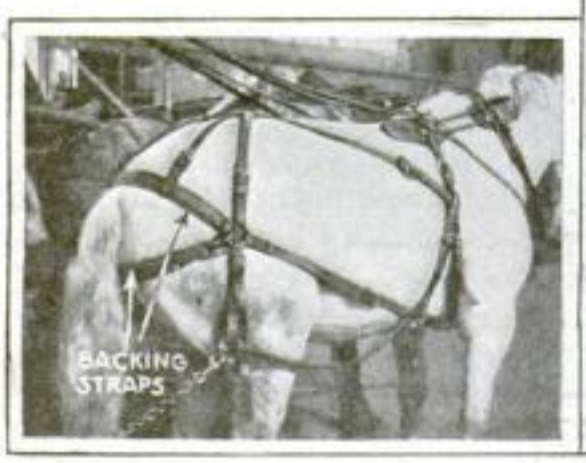
A New Collarless Harness for the Horse

WHAT is claimed to be the most revolutionary step in the advancement of horse haulage, since the first horse was harnessed to a wagon centuries ago, is a collarless harness tried out on the veldts of South Africa and now being introduced in the United States. The harness is the invention of J. C. E. Kohler, a rancher of the Orange Free State, in South Africa, and is revolutionary in that it brings into play an entirely new group of muscles never before used by a horse in drawing a loaded wagon, the pull being made from the widest part of the horse's girth instead of from the neck.

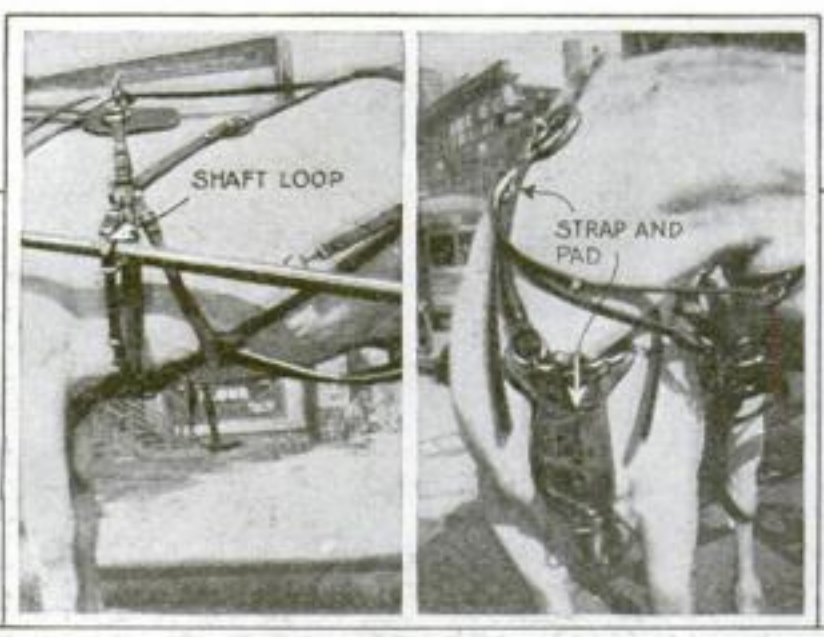
It is the claim of the inventor that the use of the neck muscles and those of the fore legs for pulling interferes with the locomotion of the horse itself; and he points out that pulling from a heavy collar results in an irritated neck

The new harness is lighter than the conventional design; it is also cheaper. It may be employed for a one-horse wagon or for a double team by the addition of two extra shaft straps for a one-horse rig. For a double set, the only change necessary is a slight shortening of the center shaft-pole. The strap around the horse's greatest girth from which the pulling is done is connected with a pad between the two front legs at the top and held by a light strap around the neck where the collar is otherwise placed.

The new harness fits tightly around the hind legs at the rumps and thus makes backing up much easier.



A rancher of South Africa claims that the horse has been harnessed inefficiently ever since the first member of the species was subsidized by man



This rancher, J. C. E. Kohler, has invented a new kind of harness, which brings into play the correct muscles for drawing a load, the pull being made from the widest part of the horse's girth instead of from the neck

The new harness is collarless, and the horse is spared painful sores that the collar often causes. It is also lighter and cheaper

A Talking Machine that Uses Thread for Records

By P. Schwarzbach

When he speaks into the horn, a diaphragm at the other end vibrates and a stylus makes impressions on a moving thread

Here is a less complicated thread recording-machine for children. After the speaking or listening apparatus is attached, the thread is set in motion

He's listening to the tale of a thread. Since the thread is very cheap and much more durable than the usual hard-rubber records, we may soon expect to find it in all fields of talking machinery

"LEND me your 'Aïda' thread." This request may sound strange to you now, but it is quite possible that before long you may be saying those very words yourself. For Mr. E. Steiger, a Swiss, has invented a sound-recording instrument in which thread is used for the records, instead of hard rubber. Imagine a thousand yards of opera thread! It would perhaps fill one small spool; yet when played on the reproducer would deliver much more music than the largest hard-rubber record made today.

The thread is ordinary thread treated with a coat of a specially prepared composition that is very sensitive to sound when it becomes hard. It is not affected by temperature, nor does it require any special care. Thus it is both inexpensive and durable.

The blank thread is stretched over pulleys in the recording machine. There are two main pulleys that hold the thread directly underneath the recording stylus, and there are auxiliary pulleys that help keep it taut. When a record is being made, the thread is moved forward at a uniform speed while the record-maker sings, talks, or plays into a horn. There is a diaphragm at the other end of the horn and a stylus attached to it. Each sound-wave is recorded on the thread by this stylus.

One picture shows a man dictating in one of these machines. He holds the horn in one hand and a handle in the other. He turns this handle slowly and evenly as he speaks into the horn, and it sends the thread on its way by further pulley action. It is so small that you can carry it on business trips. After dictating a number of letters, you cut off the used thread and send it in an envelope to the office, where it is run through a machine which has a receiving set attached to it. The operator listening to the spoken words transcribes them on a typewriter.

There is still another important use for the thread machine—in the home. Suppose some member of the family is far away. The letters that you send each other are practically the only means of communication you have. Would it not be more comforting to hear each other's voice? A few yards of talking thread would make it possible.

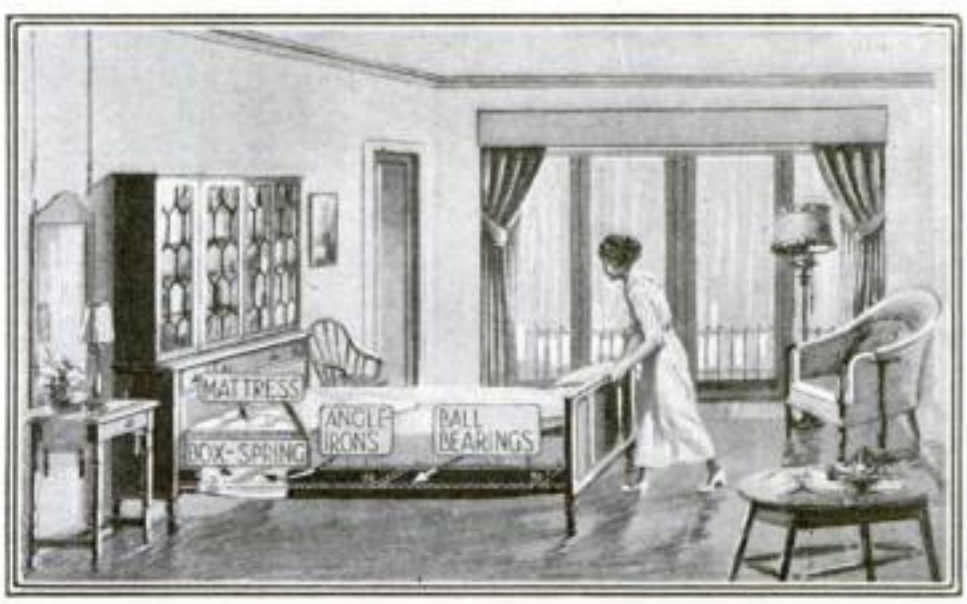
Most of the machines are operated by hand. There are some machines, however, in which this is done mechanically, insuring an absolutely uniform movement of the thread.

Push the Bed into the Wall and Forget It

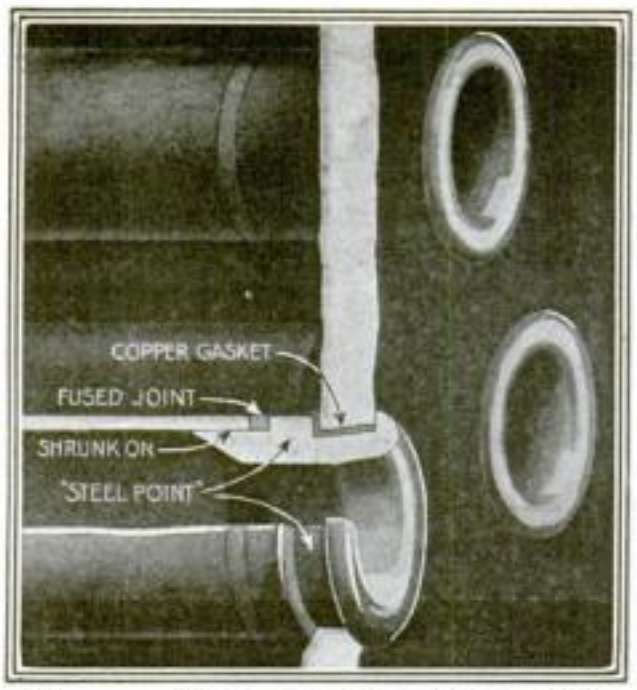
THE new drawer bed is an invention introduced by J. G. Stickley, of New York. A comfortable bed of normal size is so arranged that it disappears into the wall when not in use.

The bed operates on ball bearings on a track built under the dressing-table in the adjoining dressing-room. In the morning the bed-clothes may or may not be removed, as desired, but the springs and mattress are left on the bed. The mechanism is unlocked by a simple operation that involves no lifting; then a slight shove causes the bed to slide easily through the wall into its place under the dressing-table. The footboard of the bed becomes the finished base of a bookcase that is built into the wall. The footboard fits exactly under the bookcase and makes a complete piece of furniture, giving no inkling that it is part of a bed.

Now step into the small dressing-room and see what has become of the bed. Open the doors under the dressing-table. There it is, mattress and springs, with the spread and pillows.



In the present-day apartment-house a bed that takes up no more room than the paper on the wall is a boon indeed



To prevent leaks in boiler-tubes. The tube end has a square shoulder that rests tightly against the plate, with a copper gasket pressed between

Leaky Boiler-Tubes Will Weaken the Locomotive

A LOCOMOTIVE can be no more efficient than its boiler-tubes. When they are leaky the locomotive loses its power rapidly, and it must either be repaired at considerable expense and loss of time, or run with low efficiency. When a locomotive stands idle in the repair-shop, the railroad it works for is minus just that much of its equipment and whatever it is capable of earning in hauling freight or passengers.

Until recently, preventing boiler-tubes from leaking has been a vexing problem. A thousand and one different methods have been proposed and tried without satisfactory results. It is only recently that a practical, leak-proof joint has been devised. This new method of inserting tubes in boilers, which is the invention of Charles S. Coleman, of Los Angeles, California, is illustrated herewith. The tube end has a square shoulder that rests tightly against the plate, with a copper gasket pressed between. A slight bevel is given to the hole into which the tube end fits, and this "wedge effect" also helps to prevent leakage when the locomotive is in service. The boiler-tube proper is shrunk on the tube end and the joint fused.

This method is a great improvement over the old expansion method, which was really only half a remedy. A tube forced into place by the old expansion method is shown.

The new method of holding boiler-tubes in place has been found ninety per cent efficient and results in a saving of from ten to twenty per cent of the fuel consumption. This also means from ten to twenty per cent more mileage obtained from each tender-load of coal. The saving of fuel results from maintaining the boiler pressure at normal.

An Automatic Chemist

ONE more machine to replace human labor! This time the services of an analytical chemist are dispensed with. Philip E. Edelman, an electrical engineer of New York city, has devised an apparatus that will stand watch over a chemical process and act more efficiently than a well-trained chemist.

In large chemical plants it is the duty of a routine chemist to watch certain processes. He must do this through analysis. At certain periods of the day or night he takes samples of the "mix" to determine whether or not the proper quantity of the various ingredients is present.

In paper-mills, the sulphurous acid used in the bisulphite process must be held to a free sulphur-dioxide content of two per cent. It is the duty of the chemist to see that this percentage is held. The automatic chemist will automatically regulate the ingredients.

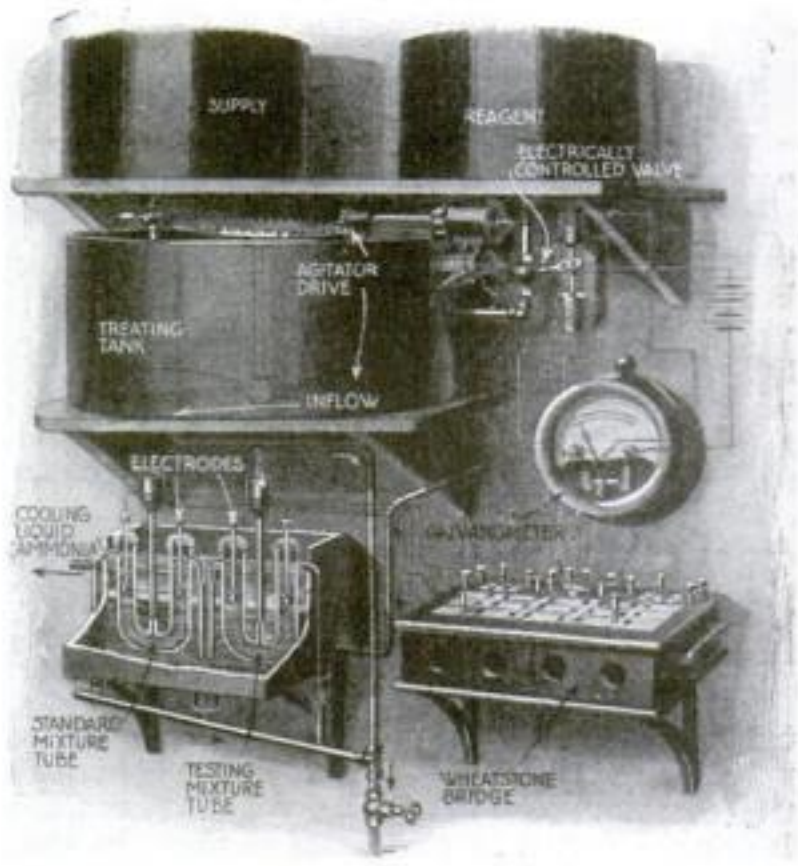
How does it work? Every chemical mixture has a certain electrical resistance, or, we might say, it has a certain degree of electrical conductivity. This degree of conductivity depends entirely upon the percentages of the various chemicals present. Some mixtures have high conductivity, while others offer great resistance to the passage of an electrical current.

Since slight changes in mixture vary the electrical conductivity, an especially designed electrical controller is made to follow closely such changes automatically and to keep the ingredients of the liquor at certain values. This is done through an automatic valve, electrically operated.

Any change in the acid content will change the resistance of the solution or liquor. A relay closes a motor circuit, which operates an electric motor connected with a valve. The valve opens and allows acid to flow in.

When the conductivity of the solution is brought back to normal through the addition of acid, the valve is automatically closed.

Such an apparatus as this of Philip E. Edelman will do much to overcome errors of judgment by the chemists.



This arrangement of apparatus will perform all the duties of a routine chemist

It Thaws Out "Empties"

Thawing out a frozen "empty" with a huge gasoline blow-torch, thereby saving time and money

WHEN empty coal-cars are returned to the mines in the wintertime, the hoppers on the bottoms are often frozen up. In stubborn cases, several men must work half a day or more to pick the ice away. One man can do the trick in a few minutes if he is provided with this large gasoline torch. A separate tank contains the fuel, which is fed to the burner through a rubber hose. The burner is mounted at the end of a long pipe that also serves as a handle. A valve at the end of the pipe allows the workman to adjust the flame.

When a frozen "empty" is received at the mine, the workman directs the big, hot flame of this torch against the parts giving trouble. Things start to crack and sizzle and in a few moments the mechanism is loosened up and the car is again ready for business over the shining steel tracks.

Is the Ouija-Board Controlled Subconsciously?

This Hindu scientist's invention may tell

By Herbert Asbury

THERE has always been a great deal of controversy about the ouija-board. Its most zealous supporters contend that the messages which are spelled out by the little triangular table are in reality communications from the dead, while the skeptics have held all along that if the operator does not knowingly manipulate the board, he at least does so subconsciously.

Sunker Abaji Bisey, a Hindu scientist, has invented a new sort of ouija-board by which he believes it will be possible to settle absolutely and without doubt the question of conscious or subconscious operation and manipulation. It is not possible for an operator to control the Bisey ouija-board, which he has called the "spirit typewriter." It is constructed of steel, and writes only when the triangular table is operated upon a steel tray, which is fitted with blind keys connected with an invisible ribbon, such as is in common use on all typewriters. The operator does not see what he is writing until he has finished, and then the paper which has recorded the progress of the table is taken from its hiding-place and he sees the message.

The triangular table is nothing more than a piece of steel fitted with three casters or rollers, as ordinary ouija-boards are, the tray on which it moves being the mechanical part of the invention. This tray is fitted all around its circumference with a series of pegs, between each two of which is a typewriter key. The keys correspond to the letters and numerals found on an ordinary ouija-board. As the triangular table under the hand of the operator travels about the steel tray under whatever influence it is that actuates a ouija-board, one or another of its three angles, instead of touching the letters, as is done on the wooden and visible board, pokes its point between the pegs and strikes a key. Each key is connected by a lever to a letter or numeral beneath the tray, and a touch between the pegs impresses that key or numeral upon a typewriter ribbon, which is also hidden. At the end of the sitting there is withdrawn from the machine a paper on which is noted every letter or numeral struck by the triangular table. The ribbon moves one space after each printing of a letter.

Sunker Abaji Bisey operating his "spirit typewriter," fitted with blind keys connected with an invisible ribbon

The tray upon which the ouija moves is round, and all of the pegs and posts upon its surface are perfectly plain faced and exactly similar to one another in appearance. Set an operator before the board, turn it about several times, and it can easily be seen that the board cannot be knowingly manipulated.

The following description of the invention as furnished by Mr. Bisey to the Patent Office may more clearly explain the mechanism in connection with the drawing:

"A circular tray is mounted on a suitable frame, and its surrounding edge is divided into thirty-six equal parts by pegs. The space left between the pegs is occupied by the button of the key lever. There are thirty-six such keys—one for each letter of the alphabet and ten numerals. The operating board is made triangular and any of its corners is designed to enter the gaps between the pegs. A circular board is pivoted on the triangular board and serves as a hand rest. A paper ribbon and ink ribbon are mounted on rollers and placed underneath the tray. No letters or signs appear on the key buttons to prepare the mind of the operator, who can operate the apparatus placed before him in any position."

Mr. Bisey's invention is an ingenious version of the overworked ouija.

Traffic Does Not Wait on This Track-Welder

ELECTRIC welding has reached a point of development where its application is growing daily. All of the rails on electrical railway systems are held together not only with bolts and fish plates, but with a permanent weld that is an added security against accident and deterioration. The weld eliminates the possibility of the rail joints becoming loose.

Here is a new electrical welder in use. This particular type is a very recent development, all superfluous parts having been eliminated. It is mounted upon three wheels so that it may be rolled along the track and easily moved from place to place.

When a street-car comes along, the men roll the small dynamotor off the track and allow it to pass. This requires but a few minutes

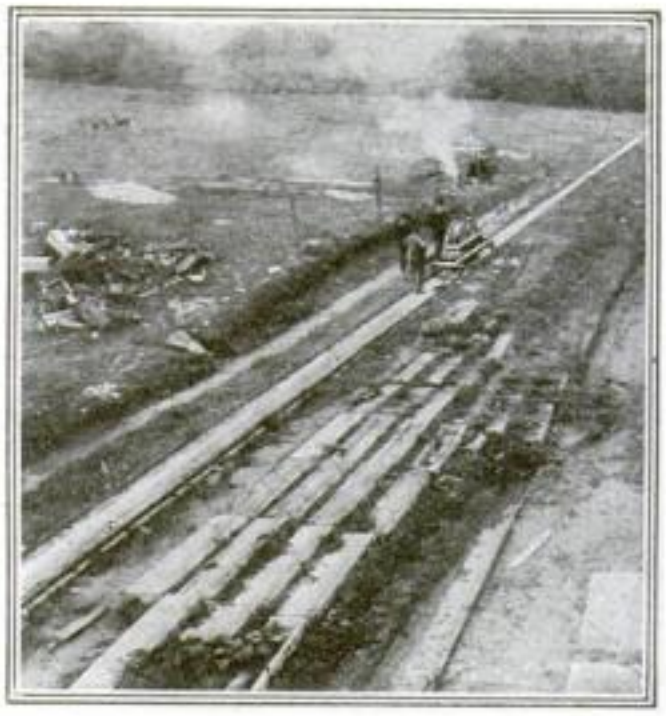
The dynamotor takes the current from the system when it is connected to the rail and trolley wire. It converts this current into one suitable for welding purposes.

A man is shown hooking one wire over the trolley with a long pole.

The man at the left of the picture is adjusting a carbon mold to a rail joint in preparation for the welder, who is seen working at the right of the picture.

Testing a Road Before It Is Built

The testing wheels run in tracks beside the road slabs. One pair of wheels having a spring attachment weighs nine thousand pounds; the other unsprung wheels weigh three thousand pounds. When dropped on the road below, they have the same effect as a seven- or eight-ton truck



Road materials are now given heavy-weight tests by the government. Here are forty-nine sections of different road compositions. Heavy wheels are dropped on each section and their comparative resistances determined

The road materials also receive a pile-driving test. The pile-driver has a one-ton weight with a rubber shoe at the bottom and a truck spring attached to the top. A second weight, of three tons, is also used in the test

BANG! You drive over a hole in the road, get shaken up, break a spring on your car, and say things about state roads. The road materials are usually at fault; they should have been thoroughly tested before they were put down.

That's what the government is doing to-day—testing forty-nine different kinds of road composition by heavy-weight methods. The various mixtures are made up into slabs seven feet square, of different thicknesses.

All sorts of concrete mixtures, different kinds of bricks on concrete bases, sand and cement—all are given their chance to prove their merit.

The slabs are laid end to end, and over them an impact machine is drawn by cable. The machine travels in tracks at the sides of the slabs, and carries in its arms two pairs of heavy wheels, one pair having a spring attachment and solid rubber tires. The wheels are dropped on the various slabs, and they have the same effect on the road material as the rear wheels of a seven-and-a-half-ton truck. The unsprung wheels—those having no springs to help absorb shock—weigh three thousand pounds and the sprung ones nine thousand pounds. By watching the surface of the various slabs after the weights have been dropped on them several times, it is easy to determine which mixtures will stand up best under traffic conditions.

There is another test that is used—the pile-driver test. But in this case there is no pile for the weights to fall on; they fall directly on the slab. The lower weight, weighing one ton, is long, thin, and has no spring to absorb the shock when it drops. There is, however, a hard rubber shoe at the bottom. On top it carries a full-sized truck spring which receives a second heavier weight that is dropped from above. This three-ton weight is cushioned just as a load on a truck is cushioned. Both weights are raised by a cam that is operated by a gasoline engine. As the cam turns over, it drops the load, and the combined weights have the same effect on the road as the rear wheels of a truck passing over an obstacle.

The weights can be dropped from different elevations up to a maximum of four inches. When dropped three and a half inches, the impact pressure equals sixty thousand pounds.

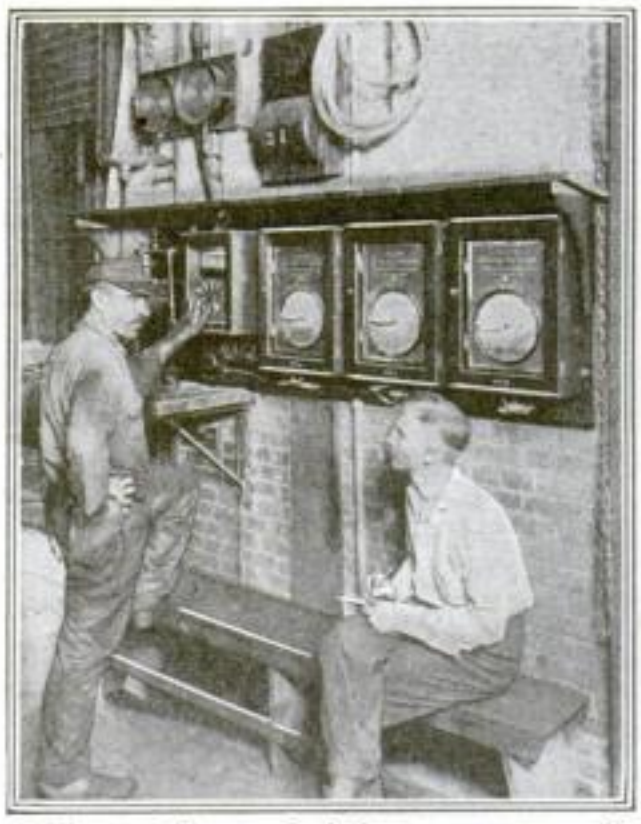
The amount of weight to be dropped can also be varied. In this way it is a simple matter to duplicate virtually all the shocks on an average road.

The pictures on this page show the two methods of road-testing described here. The pile-driving tester was photographed when the three-ton weight was being raised. You can clearly see the rope and pulley used for the purpose.

The slabs that it pounds are placed close together, but they do not touch each other. They may be seen at the right in the photograph showing the heavy wheel tester in action.

To Prevent Heat Waste in Furnaces

YOU pay so dearly for coal these days that none of the heat it gives off should be wasted. Watch the temperature in the smokestack closely and you will be able to tell whether your furnace is delivering your money's worth in heat. But how can you watch this temperature? By means of a pyrometer—a kind of thermometer that records high temperatures.



When wishing to find the temperature of gas in the flues, he turns a switch and is answered in five seconds

The sensitive element of a pyrometer consists of a thermocouple, which is made up of two wires of dissimilar metals that are attached to a delicate current-recorder. When the couple is heated, a current will be produced and the pointer on the recorder will register the amount, which increases with the temperature.

To find the temperature in the smokestack, place the couple in the stack. The current generated is translated into degrees of temperature and is constantly recorded on a scale situated in a near-by room or in a distant superintendant's office. The message of the furnace is electrically conducted. If the temperature is too high, something is wrong with the system. In connection with the temperature scale, there is a continuous recorder very much like a recording barometer.

Learn How to Refinish Your Automobile

Save sixty dollars by doing it yourself

THE public in general has the impression that an old automobile cannot be properly refinished outside of an automobile paint shop. Nothing can be farther from the truth if this work is taken up in a systematic, workmanlike, and thorough manner. It is possible that the amateur, provided with proper instructions and a working knowledge of the steps to be taken, can paint his car for twelve or fifteen dollars when the same job would cost him fifty or seventy-five dollars if done in a commercial garage.

It is possible for the automobile owner to finish his car this winter, providing he has some spare time and a quiet place to work. Painting an automobile takes considerable time, because each coat applied requires a certain amount of time to dry, and this perhaps is inconvenient to some. It is no worse, however, to have your automobile laid up in your own garage where it can be worked on from day to day, than it is to have it in a public garage or paintshop for a week or ten days. The main factor resulting in failure is carelessness. The automobile owner equipped with the proper tools, materials, and some spare time, if he is careful, need not fear the outcome.

A great many attempts at automobile painting fail because of the lack of proper materials. For instance, when oil is used as a thinner in place of turpentine, the coat does not harden as it should and does not stand the rubbing and smoothing processes. Also, when cheaper house colors are used in place of colors ground in turpentine, a greasy smear results which does not dry in the right manner. At the outset, then, one should determine to use the best materials available.

A list of the materials required: Metal primer, obtained from any well-known varnish manufacturer.

Rough stuff: this is usually procured in cans at twenty-five or thirty cents a pound and is a sort of a heavy paste. It is to be thinned with turpentine to a thick working consistency and is then ready to be brushed on.

Some of the Materials Required

Other materials required are white lead, dry white lead, dry bolted whiting, turpentine, coach japan, and raw linseed oil. After the painting of the automobile is finished, a good quality of varnish is required to cover the body and retain its gloss. Directions may be had from any paint manufacturer.

It will be well to have four or five brushes on hand. A large flat brush 3 in. or so in width will be required to put on the rough stuff, primer, and lead coats. A 2-in. brush of better quality should also be on hand to apply the color coats. A little extra expense in procuring a good brush will be well worth while. For it is essential to have the color laid on in smooth, even coats. A large, thick brush is the best for putting on the varnish. It is necessary to put the varnish on as rapidly as possible, and for this reason a large, first-quality brush will be the best. All brushes work better after having been used for a time and if new brushes are purchased, they may be broken in by saturation with oil and using them briskly on a board for fifteen or twenty minutes. As they are used they become more pliable. A good way to keep the bristles from bending and becoming deformed is to bore a small hole in the base of the handle at a suitable height and after preparing a small can of linseed oil, run a wire through the hole, resting it upon the edge of the can, thus supporting it in a perpendicular position.

For the rubbing material, sandpaper, emery-cloth, or steel wool have their advantages and disadvantages. Steel

After the old paint has been removed, fill all dents and cracks with putty

wool or emery will perhaps be the most effective and but a small quantity will be required. The grade should be fine or very fine. Pumice-stone is preferred by some, but is more expensive and the steel wool and emery-cloth will serve nicely.

Aside from the tools mentioned above, a few vessels, a chamois-skin, a large brush, and some cotton rags will also be required.

It should be understood at the outset that the automobile must be free from dust and drafts when it is being painted.

The first thing will be to thoroughly wash the automobile. This may be done outside, and plenty of water should be at hand. Go over the body and chassis and soften all chunks of mud and hardened dust. After the dust has been removed, mix some kerosene and turpentine together in equal proportions and with this solution thoroughly soak all oil and grease spots that were immune to the water. This solution loosens any remaining spots and they can then be rubbed off.

Carefully go over the entire automobile, looking for checks, cracks, portions of the body where the paint has chipped off, and then decide whether or not it will be necessary to remove the old paint. Providing the body is reasonably free from these blemishes, a lot of time and work may be saved by leaving the original color on. If there are but few spots where the paint has chipped off, or only an occasional crack or check, it will hardly be wise to remove the paint. Should there be many of these defects, however, the only safe and sane method will be to take off the paint.

Assuming that the automobile is in a condition to warrant a complete job of finishing, secure a liquid paint and varnish remover, or a gasoline blow-torch. The liquid remover comes in cans and is accompanied by thorough and accurate directions for use. This liquid thoroughly softens the old paint in a short time so that it may be scraped off easily with a putty-knife or other dull-bladed instrument. The entire surface is then washed with turpentine, removing the last vestige of the old surface.

How to Use the Blow-Torch

If the blow-torch is to be used, hold it in your left hand, and with a putty-knife in your right, go to work. Hold the flame 3 or 4 in. from the surface and go slowly back and forth over a small area until the paint is thoroughly blistered. Follow immediately with the knife, scraping off the scales as fast as they are loosened. When one small patch has been treated, select another, and repeat operations. The blow-torch method is not as satisfactory as the other, for on almost every occasion now and then a spot will not come off with the application of the heat, and is, instead, burned on to the metal. It is then necessary to use sandpaper or varnish remover.

After the automobile has been freed of all paint and cleaned with the kerosene-turpentine solution, carefully go over all sheet metal and take note of any dents, cracks, or depressions which may be there. These are then filled in with solder or putty and smoothed off with emery-cloth. Solder is better than putty, for it is permanent and stands more hard use than putty, but putty is more easily applied.

After the body has been thoroughly cleaned, it should be gone over with a medium grade of sandpaper. This process roughens the surface of the metal slightly, and enables the first coat, or primer to adhere firmly. Too great emphasis cannot be laid upon this first coat. Any grease or foreign matter between the metal and the first coat will eventually result in a chipped-off place.

(To be continued)

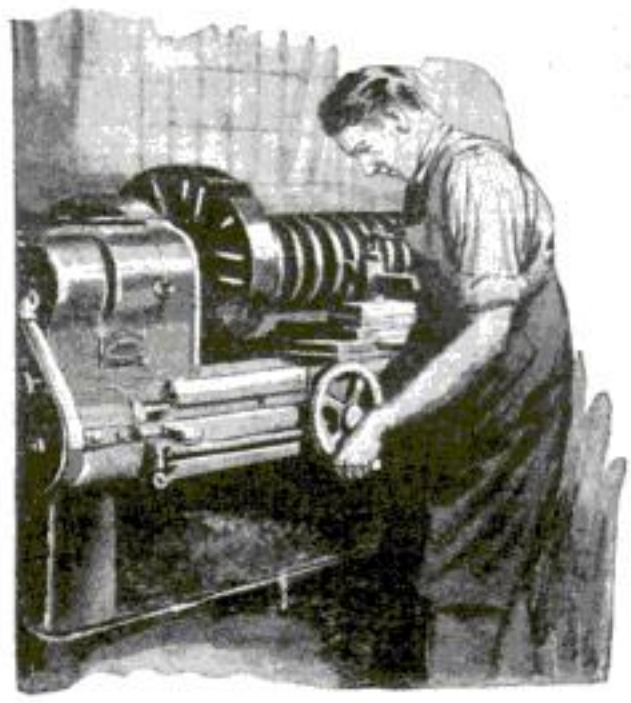
Repairing a Cast-Iron Roll Under Difficulties

By W. S. Standiford

IN every mechanic's life emergencies will arise that call for rapid thinking and original work on his part in order to keep the wheels of industry running smoothly.

In this article the writer tells how he made an emergency repair on a broken roll that lasted until the roll was worn out. When a bar was going into No. 2 pass, a sliver on it jerked the tongs from the hands of the roller and it was jammed between the side of the bar and collar, separating grooves 2 and 3; the result being that an 8-in.-long section of collar was broken out. Owing to conditions, welding supplies were unobtainable; a new casting could not be had in less than three weeks, four days more being required for turning a new roll.

The writer was delegated to make a mechanical repair if it were possible to make it withstand the side pressure exerted by the iron during rolling. A patch the size of the broken section and screwed to roll was first thought of, but rejected as impracticable as, both joints being near one another, the patch would spring and shear the bar. It was decided to cut the cast-iron collar off the roll altogether and replace it with a wrought-iron one, the joints of the halves being a long distance apart. To enable it to withstand side pressure, a slot having a slight taper and 2½ in. deep was cut into roll, the width being 2¼ in. After the slot was turned, a hardwood templet was made. The length of the two halves was ascertained by the "cut-and-try" method until, when placed in the roll grooves opposite one another, they made a snug fit at the joints and bottom. From these templets a wrought-iron collar was forged and turned with a taper matching the slot; the tapered section being a few thousandths of an inch larger so as to make a forced fit in the slot. Half of the wrought collar was forced in the slot as far as it would go by using hammers, a heavy iron ring was then put over the half collar, and 4 jacks, one opposite each joint, and others spaced equal distances apart.



How a broken cast-iron roll was replaced with one of wrought iron

Part of the ring in front of the jacks was filled with iron blocks. The jacks were then screwed up, care being taken to get equal pressure until the collar touched the slot bottom. The collar was drilled and tapped to take ¾-in. screws that extended 1 in. into the roll body. The other half of the collar was next fitted, a good job resulting. The roll was put into the lathe and the collar turned to the same size as the others. When tried in the mill, the new collar stood the heavy pressure admirably, a slight mark on the iron bars produced by the joints being removed in the finishing pass of the rolls.

Brain Saves Brawn when Fixing the Ventilator

By Edward H. Crussell

ONE day the boss took me up to the attic floor of an old-fashioned office-building to do some work on the skylight. This upper floor had originally not been intended for use and was only partly finished, the wooden roof trusses showing in all their nakedness. The main roof of the building was flat, but out of it projected, one at each end, two square towers about 50 ft. high, and the skylights were at the tops of these towers.

The top of each skylight was provided with a metal ventilator, and it developed that one of my fellow workmen, some days before, had been employed to fit the bottoms of the ventilators with hinged doors that could be closed by means of a cord from the floor below. Only a single cord was used and it was supposed that the doors would open of their own weight. As a matter of fact, it took so much cord to reach the floor, that the weight of it nearly balanced the door which, in consequence, would only open an inch or two. My job was to fasten lead weights on the doors to make them overbalance the cords.

With the height of the upper story added to that of the tower, the ventilators were all of 70 ft. from the floor, and as I looked up the inside of the tower I inquired of the boss, "How's a fellow going to get up there?"

"I don't know," was the reply, as he turned to leave. "Smith got up there all right; you ought to be able to do what he could."

There are more ways than one to fix the ventilator in a skylight

Well, when a fellow came to notice the pieces of 2 in. by 4 in., spiked here and there up the sides of the tower, it wasn't hard to guess how Smith had climbed it. He had evidently taken a ladder, climbed to the top of it, spiked on a piece of 2 in. by 4 in., carried up a piece of plank, stretched it across the tower, then carried up another ladder, stood it on top of the plank and so on until he had reached the top.

I had no doubt of my ability to climb the inside of the tower in the way Smith had, but I had no intention of lugging half a dozen planks and ladders up to the top of a four-story building unless it was absolutely necessary.

Permanent ladders on the outsides of the towers made the tops of them (which were flat, and surrounded with an ornamental iron railing) easy of access and my first thought was, that I could go up the outside of the tower, take a couple of lights of glass out of the skylight, stretch a plank across and work from it. When I got to the top of the tower, however, I found that by taking out four screws I could lift the ventilator off the skylight and get at the top surface of the door quite easily. So I went below again, pulled each door shut, fastened the cords securely, carried up my weights, fastened them in place, and replaced the ventilators, screwing them down securely.

How to Bore a Conical Hole through Wood

WHEN you have a conical hole to bore, such as for a handle hole in a wooden maul or other similar place, leave the cutter of an expansive auger bit a trifle loose and begin boring at the side where the smaller end of the hole is wanted. The inner edge of the cutter lip being angular, the cutter will gradually draw itself out from the body of the bit, making the hole larger as the bit goes into the wood.

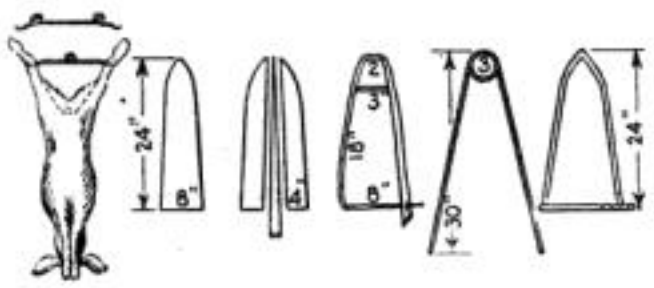
Save Your Rabbit-Skins—They Are Valuable

By Marcellus W. Meek

BREEDERS of rabbits, especially of Flemish Giants, Belgians, French Silver, Beveren, New Zealand, and other breeds of which the skins are used for making high priced imitation furs, like French seal, mole, beaver, cony, etc., will find it to their advantage to save and properly prepare the skins of their rabbits.

A brisk trade has arisen in rabbit-skins of the breeds mentioned. Fur buyers all over the country now pay good prices for skins which were thought worthless a few years ago, as their quality and fur value were little known; most of the rabbit-fur skins being imported from Europe. One New York manufacturer who manufactures rabbit-skins into near-seal, mole, and beaver-cony, and other imitations of high-priced furs, advertises for 10,000,000 American raised rabbit-skins, and will pay good prices for them. It pays to save your rabbit-skins if you are raising fur rabbits.

The illustration shows how the rabbit should be hung in order to skin the animal properly. The rabbit should be killed by a sharp blow behind the ears, and the jugular vein opened with a sharp knife. Hang the animal up as shown in the illustration, and begin skinning by cutting around the hind legs at the first joint, and slitting the skin down to the tail inside the hind legs, shown by the dotted lines. Skin around the vent. The skin is then easily pulled off "cased"—inside out like a glove. When the forelegs are



The proper way of hanging the rabbit and some devices for stretching skins

reached, a little deft work with the skinning-knife will remove the skin nicely. Cut around the neck, as it is not necessary to skin the head. When removed, the skin must be stretched and dried.

Fur dealers prefer "cased" skins. Fur stretchers are easily made as shown in the drawing, either from thin boards or wire. The wire stretcher which has a loop in the top is very easily made from ⅜-in.-gage wire, and is inexpensive. Rabbit-skins must be dried in a cool, dry place—never in the sun or where it is damp. Free circulation of air is necessary.

After the rabbit-skins are dried, they should be sorted as to size and quality, and each lot tied up separately. Burlap or grain sacks are the best for shipping skins. A card should be placed inside the bundle with name and address of the shipper, and the outer tag should give the name of the house to which shipment is made, as well as the name and address of the sender. Be sure to write plainly in ink. The sacks should be sewed up instead of just tied. Don't use sacks full of holes, and don't use wires to tie up the skins, as these might cut the pelts. It is best to ship by express or parcel post.

Although winter skins are preferable, many buyers will take summer rabbit-skins, as the rabbit often has prime fur in summer and fall as well as winter. Rabbit-skins are graded into "prime" and "unprime" skins—the unprime skins showing black spots or splashes on the back where the new hair is coming in. Both grades are sorted in four sizes—very large, large, medium, and small. The least valuable grades are used for felt hats, and are termed "hatters' fur;" these are bought by the pound. The better grades are bought by the piece.

Move the Automobile Tires Forward as They Wear

By Robert A. Chandler

IF he will change tires around in the manner described below, a motorist can make them last far beyond the usual mileage. This is done by reducing the strain on the tires as they wear away so that the newest tire is placed at the point of greatest strain and the oldest one at the point where the strain is least.

It is evident, even to a casual observer, that the rear tires wear out more rapidly than those of the front wheels. This is due to the strain of driving through the rear wheels, letting in the clutch, applying the brakes, use of chains, skidding, and so on. Now comparing the right side of the car with the left, the tires on the right wheels will wear faster. The left wheels run along the smooth part of the road where the ridges and ruts are all beaten down by the traffic. But near the edge the road is rough, there are more ruts and small stones, and sometimes these wheels must leave the road altogether. There is more likelihood of meeting broken glass, metal, and other objects on this side. Then there is more weight on these wheels because the car is tipped more to that side on account of the crown of the road. Therefore it may be stated as a general principle that the rear tires

Changing the tires according to the system here explained will mean a saving

wear more than the front ones and the right ones more than the left.

Starting with all new tires it will be evident that the right rear tire will show serious wear long before the left front tire has got over its newness. At this point the two should be exchanged. It is difficult to state just when this change should take place, possibly it is best left to the discretion of the driver. If a "non-skid" is used, the change should be made before the tread is worn so smooth as to lose its protective feature. At the same time the other two tires should be exchanged to keep matters even.

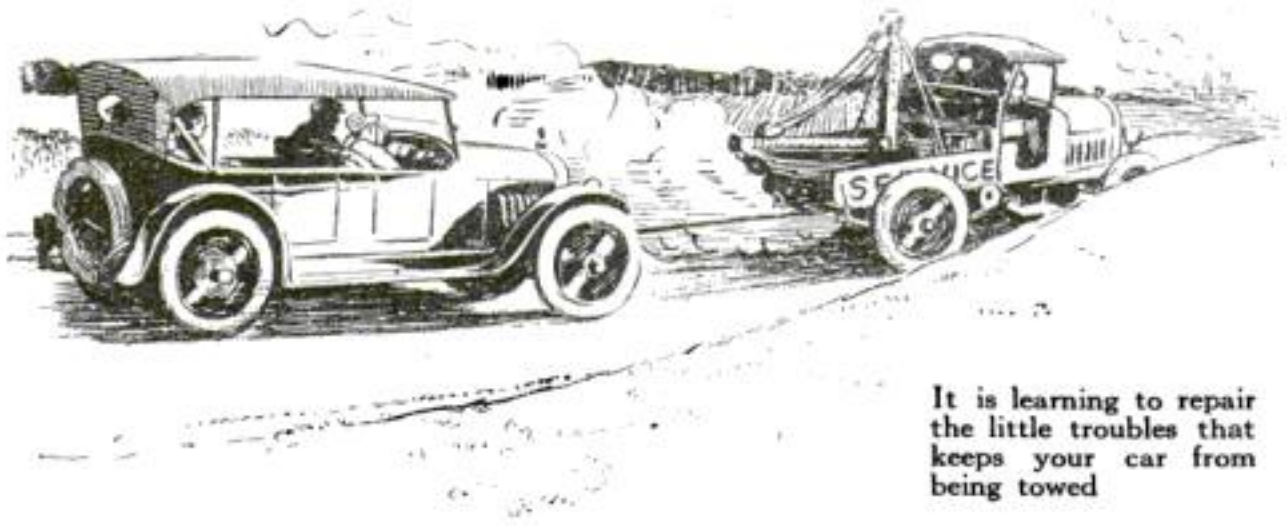
After a few thousand miles more we enter the second phase. One by one the tires will wear out and not even vulcanizing can save them. They must then be moved up in the sequence shown. Supposing the left front tire is discarded, the right front tire takes its place; the left rear tire moves forward and the right rear tire takes its place. The spare tire is placed on the right rear wheel, the point of greatest strain.

Of course if some tire is to be removed temporarily for repairs, it will be replaced by the spare tire instead of moving the rest forward, and as soon as returned it is put back in its regular position.

By following the above system you will not only make your tires last longer, but you will have less trouble from punctures—another good reason for following this practice.

The logic of the advice given by the author is unimpeachable and is based upon a careful study of the subject. Tests, extending over a period of several years, have proved beyond reasonable doubt that the rotation method suggested will actually result in a considerable saving of time, labor, and money to the owner of the car.

Don't Let the Tow-Car Get You



It is learning to repair the little troubles that keeps your car from being towed

DON'T condemn a spark-plug unless it is at fault. To determine this, first find out which cylinder is missing explosions. Short-circuit each spark-plug with a screwdriver. If the engine slows down, it is a live plug. If it doesn't, that cylinder is not firing.

Disconnect the wire from the spark-plug and run the engine. If a good spark jumps from the terminal when laid upon the cylinder head, the trouble is in the plug or in the cylinder. If there is no spark, the trouble is in some other part of the ignition system. If a good live spark is shown, remove the plug and lay it upon its side on the cylinder head with its terminal attached. If it shows no spark, the trouble is in that plug.

Clean off the carbon with a cloth dipped in kerosene or use a brush. Touch up the points of the plug with emery-cloth, but do not scrape the emery on the porcelain, as that scratches it and makes it soot up all the more readily. A cracked core must be replaced.

Put the parts together and adjust the gap to approximately the thickness of a very thin dime. Try it again in the cylinder. If the engine misfires, the trouble may be a loss of compression or faulty carburetion.

Be sure to carry an extra set of lamp-bulbs, so that one can be replaced as soon as it burns out. You should know the candlepower of the bulbs in your headlights, side lights, tail light, instrument light, and dome light. Take them out now and make a memorandum in the box with the bulbs, and so insure your lighting future.

How long is it since you went over the connections of the steering mechanism to see that they were fastened securely? This should be done at least once a week, as more damage can be done by failure of the steering mechanism than by any other cause. See that lock-nuts, lock-washers, and split-pins are doing their duty. Try each nut with a wrench even when it is secured by the means mentioned.

There is more wear on the side walls of the right tire, due to the increasing use of the left-side drive. Some drivers have learned to drive up close to the curb without touching it. A little practice on your part will go a long way in making your tires last their guaranteed mileage.

Now is a good time to go over the rim to see that the various parts have not rusted together. Give them a fresh coat of paint before replacing them. If this is not done, the rains will rust them together so that a demountable rim will become a permanent fixture on the wheel.

The skilled driver rarely uses his brakes except for an emergency stop, or when going downhill. Learn to judge the distance and let your car coast to the point at which you wish to stop. This will save the brake linings and other parts, so that they will not have to be replaced so often.

The funnel used to fill the oil reservoir should have a strainer in it of very fine wire. It keeps out dirt and foreign matter which would otherwise fall into the system and clog up some small opening. One little piece of dirt might do no harm, but others would accumulate there and finally cause clogging. This matter of straining the oil is especially necessary with the type of lubricator using several small pumps, as a small piece of dirt getting into any one of the valves puts that pump out of commission immediately.

Some relief valves have handles set the wrong way, so that the valves shake open. If one becomes troublesome, replace it with another which is set properly. If this is not desired, the hole may be plugged with a piece of brass rod and a new hole drilled at right angles to the old one.

One of the many mistakes which beginners frequently commit is to rest the feet on the clutch and brake pedals. It wears out the clutch collar and makes it noisy, and this habit may also cause the brake to drag. The best position is to have the feet near the pedals ready for instant use, but not on them. Sometimes the water does not circulate properly through the water jacket on the carburetor. Run the engine and see if it warms up. If not, disconnect the lower pipe and see if the water runs through the jacket. Locate the stoppage and remove it. Remember that gasoline cannot evaporate unless heat is provided either by the water jacket or the hot-air inlet to the carburetor.

To Develop Strength in the Wrist and Fingers

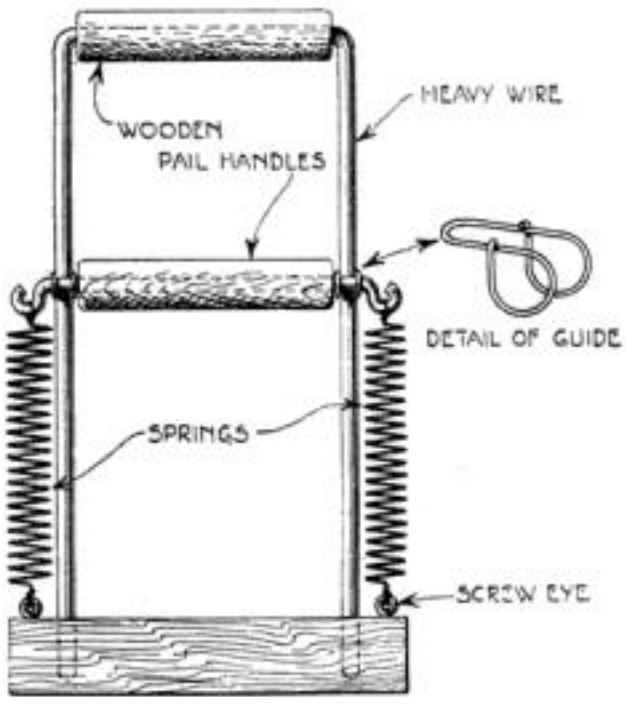
THE little device shown in the illustration is called a grip machine because it is intended to develop the strength of the wrist and fingers. It is used by squeezing the movable crosspiece until it reaches the other crosspiece. This operation practised with both hands each day for fifteen or twenty minutes, will strengthen your grip and enable you to do gymnastic stunts with greater ease.

The use of this simple exerciser is equally beneficial in restoring the strength of the hand after it has become weakened through injury.

First get a piece of straight heavy wire 1/8 in. thick and 23 1/2 in. long. Sharpen each end with a grindstone or file. The handles or grips are made from wooden pail handles 3 3/4 in. long. Mark the wire with a scrape of the file 9 3/4 in. from each end. Slip the pail-handle on and fasten it between the marks by forcing slugs of wood into the hole, then bend the wire at each mark.

Take a piece of wood about 6 in. long and 1 in. square. Drive the ends of the wire into the wood about 1 in. from each end as shown in the illustration.

Take another piece of wire of the same thickness 6 in. long. Mark it 1 1/8 in. from each end. Slip on the pail-handle and fasten it between the marks as you did the first. Bend the ends as shown and make two guards of a piece of thin wire to keep the crosspiece from pulling away from the long wire. The guards should be large enough to allow free movement of the crosspiece and should be oiled to prevent wear.



Persistent and regular exercising with this device will give greater strength to your grip in a short time

Screw two screw-eyes into the wood as shown and fasten 2 large springs—one from each side of the crosspiece—to each screw-eye. The wire can be obtained in a tinsmith's shop and the springs will be found in a hardware store.—WALTER THOMPSON.

Through a 4-in. Wrought Steel Pipe in 110 Seconds

Just before this photograph was taken, the operator released the ratchet controlling the speed, and the saw actually slashed its way clear through the four-inch wrought steel pipe in one minute and fifty seconds.

This circular, metal-cutting saw, with special teeth inserted close together and each series of four to six interlocked, is a Disston invention. Wherever used, it greatly reduces the cost of producing steel of irregular shapes such as castings or railroad tracks.

The fundamental quality of all Disston Saws and Tools lies in the Disston-Made Steel. For generations the workmen have produced the finest steel suitable for each article in the Disston list, until these men *know* steel as few men in the world can know it.

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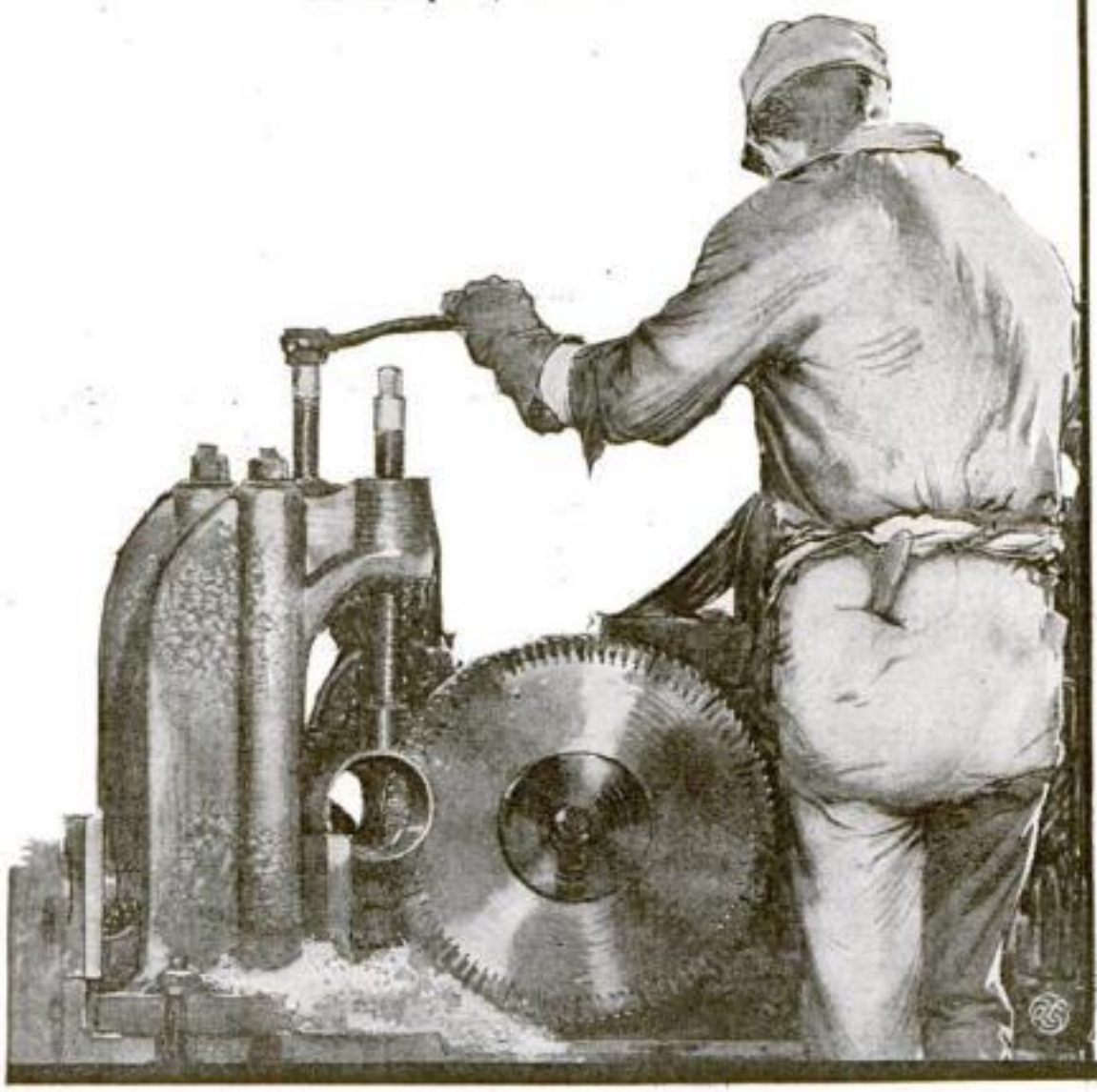

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All Sorts and Conditions of Steel

By Donald A. Hampson

WITH the advent of the automobile came the wide use of alloy steels and of the term "alloy steel" in the nomenclature of the machine trades. And as the automobile has become a necessity, people who never knew and never cared about things mechanical have become interested to the extent that a great deal of general information that was heretofore trade talk is today part of the man-in-the-street's vocabulary.

The automobile is largely responsible for the general use of alloy steel and for its use in other lines requiring high duty, but the elements that produce these advanced results were known many years before and such steels were produced and used in limited quantities. Also there are other steels that the machinist encounters at times and that are of much general interest, but that have not received the advertising that has marked automobile materials.

The Chemistry of Steel

The chemistry of steel is of the utmost importance today. Without going into that, it may be said that changes of 1/10 of 1 per cent in the amount of certain elements will make a considerable difference in the working of a piece of steel and the service to which it is adapted. A number of the striking changes in properties and the use to which such steel is particularly suited will be mentioned.

First, one or two facts should be fixed in mind. We have *mild*, or machine, steel, which is the most valuable structural material we know; roughly, it is a combination of iron and carbon, but with not enough carbon in it to make it a hardening steel. Then we have *carbon* steel, containing 0.60 per cent or more of carbon—steel that will harden, showing in the hardened state greater strength and the ability to cut other metals. If it were not that the hardness is always accompanied by brittleness, carbon steel would answer for most of the purposes where alloy steel is now used, both in construction and as a cutting steel. The increase in strength—and in brittleness—is in direct proportion to the amount of carbon added. A carbon content of 1.20 per cent is rarely exceeded in straight carbon steels.

Manganese Steel

Manganese steel is the oldest of the so-called "alloy steels." About fifty years ago, Hadfield's manganese steel was brought out for cutting-tools and marked a wonderful advance in the art, for it would stand up under far greater speeds than carbon steel. It hardens in air and from that quality it early acquired the name of "self hardening." Until the advent of high-speed steel, self hardening occupied the foremost place for cutting-tools and is still in demand for many classes of work. In its composition there is 12 per cent of manganese and about one per cent of carbon.

Every one knows that the plunging of a piece of red-hot steel into water causes it to harden, if the steel is of the proper grade. It is the element of carbon that brings about this change. Unless the brittleness is reduced by tempering or there have been other elements introduced to prevent this extreme hardness, the piece of hardened steel is almost as brittle as glass and can be shattered by a blow from a hammer. One notable exception to this is found in steel alloyed with manganese—not the composition noted above for cutting-tools, but a composition for structural purposes, the most notable example of which is the use in safe and vault building. The manganese steel of this grade is heated and plunged quickly, just as is carbon steel, and while it becomes very hard, it does not get brittle as does the latter, but is ductile and will resist almost any amount of hammering without fracture. After hardening, it cannot be cut with tools—all surfaces that require machining have to be ground.

Still other compositions of manganese steel are highly valuable for modern uses. The non-shrinking die steel, so prized by our tool-makers, contains about 1.60 per cent of manganese along with 0.90 per cent of carbon. When it is considered that ordinary tool steel will change its size several thousandths of an inch when plunged hot into water, the value of a steel that does not change at all is at once apparent, particularly in the case of an expensive die, one whose shape precludes any correction after it is hardened. The addition of from 5 per cent to 14 per cent of manganese to steel renders it non-magnetic and a poor conductor of electricity, features that make it desirable in the construction of many kinds of electrical apparatus.

Tungsten Steel

High-speed steel, the undefeated rival of Hadfield's manganese, contains 18 per cent of tungsten and about 0.65 per cent of carbon (enough carbon to make it harden). It is the possessor of the wonderful property of remaining hard at all temperatures up to and including a dull red heat. This is very important in modern machine-shop practice where such a cutting speed must be maintained that heats the chips to a temperature of 600° or over and where the tool gets even hotter and must run so for hours. In point of actual hardness, carbon steel exceeds high-speed steel, but the former loses its "temper" at a little over 400° and so must be used at vastly reduced speeds. High-speed steel, once hardened, is practically self hardening, for nothing short of long hours of treatment will change its nature to where it can be machined again. This steel is not used for anything except cutting-tools. During the early days of the war, its price rose to nearly four dollars a pound and still remains well over half that amount.

Tungsten steel of a lower grade is used extensively in electrical and instrument work. It has the property of retaining its magnetism for long periods, once charged. This makes it ideal for permanent magnets as well as in the more delicate work of compass-needles.

Silicon Steel

Another steel prominent in electrical work is silicon steel. It finds its use in electromagnets up to the largest sizes; it has a greater permeability than the purest of wrought iron, and a high resistance. An interesting difference will be noted in the last two paragraphs—tungsten steel for permanent magnets, silicon steel for electromagnets.

Nickel Steel

Nickel steel is one of the most valuable of the alloys. It came into prominence twenty-five years ago when nickel-steel bicycle tubes were made for use in the Columbia bicycle—a steel with 5 per cent of nickel that gave greater strength with much less weight. Today nickel steel is widely used in marine work for engine and ship forgings, having practically displaced all other steels. Armor-plate is made of nickel or chromium steel or steel with these two elements combined in various proportions. Armor-plate with a composition of 3½ per cent nickel, 1½ per cent chromium, and 0.25 per cent carbon can be pierced by a projectile which, if powerful enough, will go through, leaving a clean hole (as if by a punch) with no cracks radiating from the hole.

Other properties of nickel steel are its resistance to wear. Nickel steel rails last nearly four times as long as ordinary rails, and thus railroad officials specify them for the hardest service on curves. Nickel steel has a high tensile strength and a high permeability. Twenty-five per cent of nickel renders the steel non-magnetic, though this is seldom required (note that 5 per cent to 14 per cent of manganese does the same thing). A composition of steel with 30 per cent of nickel is practically non-corrosive; such steel is used extensively for boiler-tubes where its consequent long life

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makes it the cheapest material in the end in spite of its high first cost. Other applications where there is exposure to water and vapor show the same freedom from constant renewals.

Chromium Steel

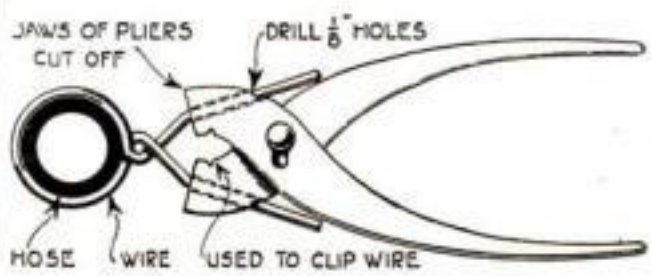
Chromium steel with a high percentage of chromium resists oxidation and corrosion well. But it is in armor-plate that this alloy steel really shines at the present time. The great hardness in the face of the plate and the great toughness at the back are secured by chromium as in no other way. From 2 per cent to 4 per cent of chromium allows the lowering of the carbon content without affecting the hardening of the steel and then the undesirable quality of brittleness is not present to an alarming extent.

This brief review of special steels will show the degree to which the steelmaker's art affects those things upon which our modern life depends. And that without touching the alloy steel as applied to automobile crankshafts and gears, or the steel that goes into the great bridges and from that down to the common implements of farming. These latter uses of mild steel—steel that before the war brought around three cents a pound—have been promoted and made possible at a low cost because alloy steels have been found ready for cutting-tools and for highly stressed parts. The mouse-trap sold over the counter of five-and-ten-cent stores was made salable at that price because high-speed steel tools were used in its manufacture and the bridge over which speeds the twentieth-century train is made safe by the use of alloy-steel pins at critical points—steel that is scientifically compounded and treated.

For Binding Hose Clamps with Wire

TO bind hose with tight wired connections a tool can readily be made from an old pair of pliers, even a pair with the ends broken.

Saw or grind the ends flush and drill with two $\frac{1}{8}$-in. holes as shown in the

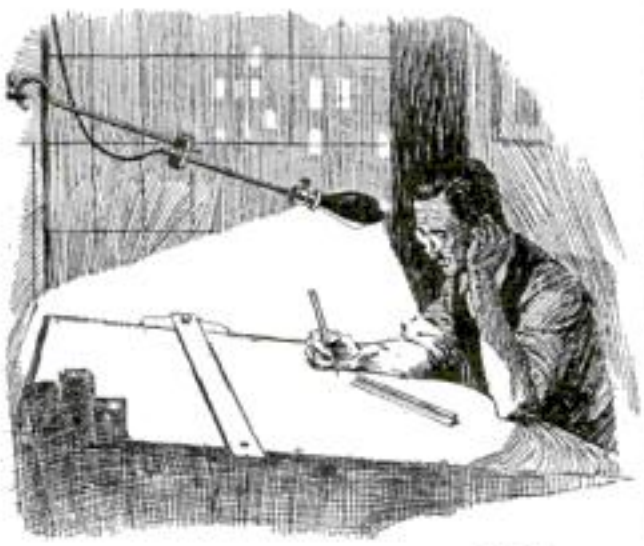


This useful tool may be made from an old pair of pliers

sketch. A U-shaped piece of wire is cut and the ends are placed through the holes after surrounding the hose. Twisting the handles makes a clamp that is both tight and inexpensive. Wire up to $\frac{1}{8}$-in. in diameter can be used with this tool and wired patches about pipes, tanks, etc., can be made securely.—G. A. LUERS.

An Adjustable Light Fixture for the Drafting-Table

FOR use above the drawing-table or over the desk an adjustable light fixture that is simple in construction, positive in the setting, is shown in the illustration. This consists of an ordinary half-round reflector secured about the lamp socket. The socket is screwed to a piece of brass tubing and



Here is one way to get good light, just where it is needed

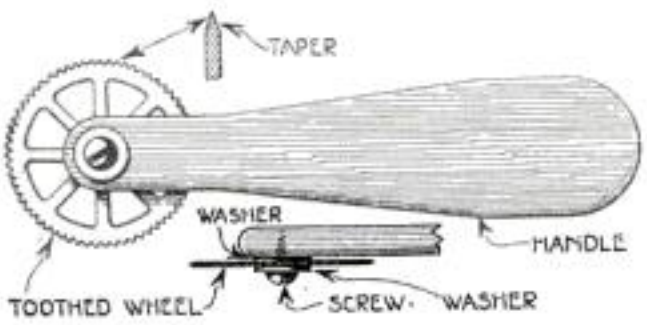
the lamp wire led through this. A short section of pipe split lengthwise with two cuts for the tubing and a set screw is for purposes of adjustment. A second section of tubing, with a circular bend in the extreme end, rests in a piece of angle-iron through which a hole slightly larger than the tube is drilled. The overhang of the lamp causes the tube to hold firmly in the bracket.—G. A. LUERS.

A Clock-Wheel Serves as a Paper-Perforator

A PAPER-PERFORATOR is easily made from an old clock-wheel.

Bevel the wheel on both sides until quite sharp. Now get a ¾-in. brass-headed screw, two small brass washers such as are used in clockwork mechanism, and a piece of wood to form the handle.

Place a washer on each side of the wheel, insert the screw, and attach to



An old clock-wheel and a wooden handle make a good paper-perforator

the wooden handle so that the toothed wheel protrudes beyond the handle end.

This tool, drawn along a page, perforates the paper quite easily, and notebooks with fast leaves may be provided with detachable pages in a very short time.—GEORGE H. HOLDEN.

How Tool Steel May Be Case-Hardened

IT is necessary for toolmakers to case-harden many tools and tool ends, such as wrenches of the S shape and straight-end styles, in order to prevent serious wear. There are many other tools which would last longer without becoming misshapen were they case-hardened after being dressed up and before use. The following method of case-hardening good grades of steel may be employed.

First, secure or make a little wrought-iron box, the size depending on the length of the tools or pieces of steel to be hardened. This box of thin iron may be shaped like a cigar-box and have a hinged lid or otherwise, just so that it may be sealed air-tight with fire-clay or such matter between the lid and box. When such a box is prepared, secure enough bone-dust to nearly fill this box. Next, cover

Case-harden your tools. They will last much longer

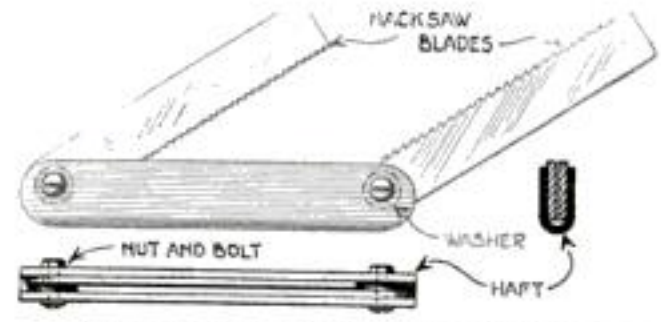
the bottom of the box with said bone-dust about an inch deep and place the tools or steel parts in this bed—being sure that no parts come in contact with each other or the sides of box. If more than one layer of steel parts is to be hardened, place another layer of bone-dust over the first layer of steel parts and then another layer of steel parts, then more bone-dust, until the box is packed tightly. Seal with fire-clay or other such substance, or pack lid of box with asbestos to secure an airtight box under heat. Then you are ready to give the box and contents the required heat and cooling treatment to produce case-hardening.

When all is ready for the fire, heat box and contents to a cherry-red heat and maintain this heat until you are sure the pieces of steel inside are thoroughly heated, which may require 15 to 20 hours, after which remove box and contents and quickly cool tool ends or the whole in a pail of lukewarm water. A pinch of salt will help. If this fails in results, repack and heat for a longer period, as the carbon from the bone-dust must penetrate the steel to give it hardness.

Making a Useful Hacksaw for the Pocket

A GOOD way of utilizing broken hacksaw blades is to make a holder, or haft, similar to a pocket-knife.

Take a 4-in. length of ½-in.-diameter brass gaspipe, cut down on one side lengthways, and then flatten with hammer until a turn cap U shape is formed, just of sufficient width to receive two thicknesses of the saw-blades.



This shows how to make a folding hacksaw from broken blades

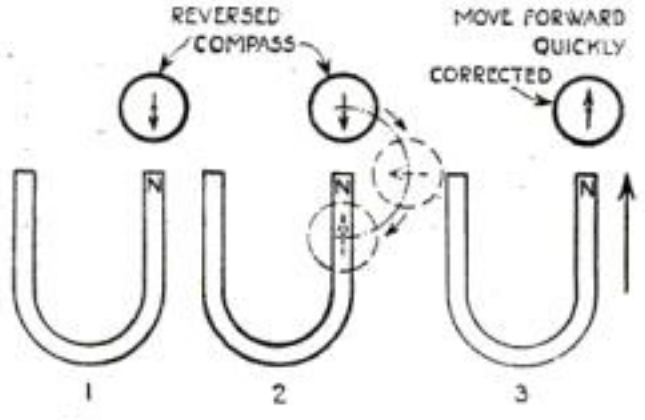
Half an inch from both ends bore a ⅛-in. hole, insert the eyelet end of a piece of the saw in haft, together with a clockmaker's small washer, and tighten up with small bolt and nut or a set screw.

The saw-blades, when not in use, will then fold over and fit in the haft like a penknife, and may be carried about in one's waistcoat pocket with ease.—GEORGE H. HOLDEN.

To Reverse the Polarity of a Compass

SOMETIMES a small compass becomes reversed through carelessness in using it near a strong magnet. As it is almost useless in this condition, it must be restored to its original polarity, but how to do this without removing it is usually a puzzle.

The compass, held level so that the needle is free to move, is brought to the pole of the magnet, which it will naturally seek. It is then brought around in a semicircle, allowing the needle to revolve as shown. This brings it over the pole. The compass is now moved forward quickly so as to catch the other point of the needle before it can get away. As this is the correct polarity, the compass is tapped a few times against the magnet to settle the molecules into place and the trick is done.—ROBERT A. CHANDLER.



The polarity of a compass may easily be corrected, as described here

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Make a Pocket-Bib for Your Baby

THE pocket in the bib described here catches the crumbs and food particles which the baby drops from mouth and fingers, and prevents them from falling on the clothing or floor.

The bib is made, like a majority of baby bibs, preferably of rubberized or other waterproof fabric.

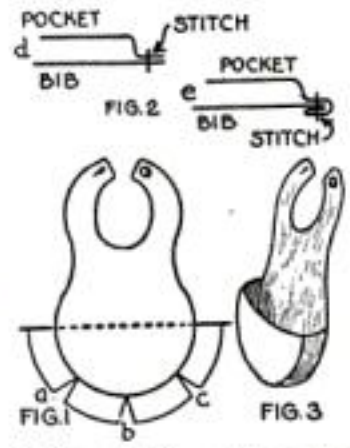
This pocket bib will help to keep baby's clothes and the floor clean

To make the pocket, lay the bib on a sheet of paper—about one third the distance from the bottom to the neck, as shown in Fig. 1.

Draw the bottom outline of bib on the paper. Around this draw another line, distant from the first line, ¾ in. at the bottom, flaring to 1 in. distant at the top edge of paper.

At the points *A*, *B*, and *C*, mark V-shaped notches as shown, so that the projecting pieces left shall be the same length at their outer edges as along the inner line.

Using this as a pattern, cut out your pocket, allowing enough margin outside the lines for a seam, and the same along the V cuts. Seam the edges of the V cuts together.



Follow this pattern for making one of these useful bibs

Place edge of pocket against *back* edge of bib and stitch flat, as shown at Fig. 2*D*.

Turn, bringing pocket in front of bib, and stitch through, as close to edge as possible, making a turned edge as shown in section at Fig. 2*C*.

Bind top of pocket with tape.

The bib complete is shown in perspective in Fig. 3. The mother may add some individual, artistic touches to her work, but, remembering the purpose for which it is intended, she should avoid everything that would make it difficult or impossible to clean the bib after use.—CHARLES A. PEASE.

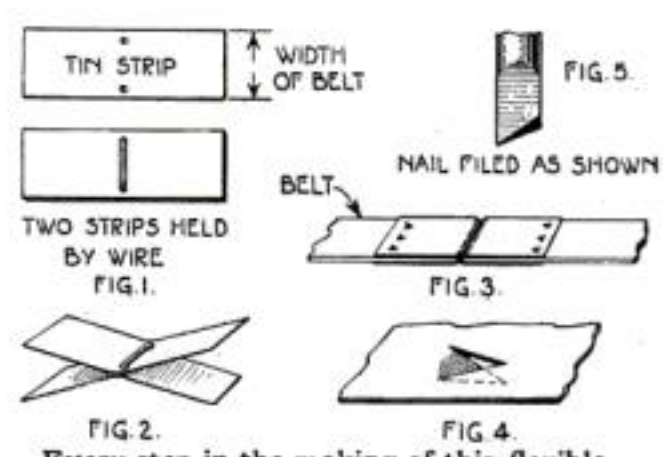
A Flexible Fastener for Small Belts

IN such places as printing-shops and other places of business where conveyors are used, the need of a small flexible fastener for connecting the ends of small belts together often arises.

The writer was recently confronted with the task of equipping a large blueprinting machine with new elastic bands. The old ones had lost their elasticity, the main quality required of them in the rolling of the printed sheet after it had been developed and dried. Wire was first used, but the ends soon frayed and pulled apart. A more substantial method, which has worked perfectly for some time, was employed in the following manner:

Pairs of tin strips, the width of the elastic belt and 3 widths long, were cut from sheet tin and small holes punched near their edges, as shown in Fig. 1, on a line running through their centers. These holes were punched through with a nail set and ground smooth. Small wires were then cut into short lengths and put through the holes and the ends clenched over, holding the two strips firmly together, also shown in Fig. 1.

The ends of the strips were spread with a knife-blade wide enough to grasp with the fingers (see Fig. 2) and the bend was completed as in Fig. 3. It will be noticed when this has been done, that a simple hinge has been made, which is held together by the doubled wire.



Every step in the making of this flexible belt-fastener is here clearly illustrated

This is now ready to attach to the belt ends, with the exception of punching the tooth-like prongs that dig into the belt, when fastened, and prevent it from pulling out.

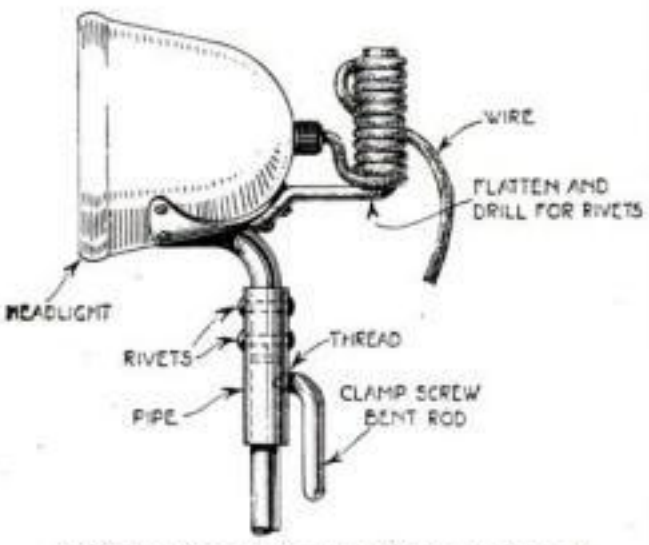
To make these prongs, procure a small nail, and grind the end to a three-cornered point. This should consist of two broad surfaces and one narrow one. Then finish by grinding off the point until the end of the nail appears as shown in Fig. 5. This, when driven through a sheet of tin, makes a mark similar to the one shown in Fig. 4. By making a row of these marks with the prongs along each edge of the connectors, as shown in Fig. 3, the ends of belting or webbing will not pull out when it has been clamped down with a pair of pliers. When using the punch, place a thin strip of wood

between the sides of connectors and be careful not to cut through both sides at once.

This fastener will hold indefinitely, providing the strain thereon is not excessive.—DALE R. VAN HORN.

An All-Purpose Headlight for the Automobile

A DETACHABLE headlight fixture as shown in the accompanying illustration affords a convenient feature for tire repairing and roadside or garage repair work on the engine or transmission. The lamp support is cut and a detachable joint made as

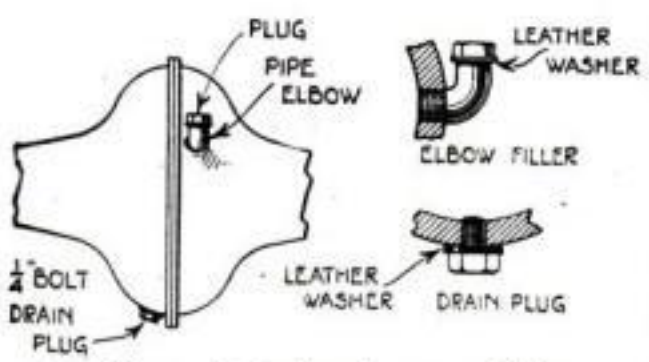


This headlight is removable and may be used to advantage when repairs are being made at night

shown. This joint is a section of tubing riveted to the lamp bracket with a clamp screw to engage the support on the car. A section of tubing riveted to the body of the lamp serves as a handle and also as a reel for winding up about twenty feet of lamp wire. This attachment is suitable for either the private car, any truck, or the garage service car.—G. A. LUERS.

Care and Treatment of the Main Driving Gears

THE section of the rear axle-housing for an automobile enclosing the driving-gears is in a large number of axles only provided with an aperture



Provide a drain-plug for your differential casing and you can flush the gearing

for putting in the lubricant. No means of draining is provided and in consequence the casing is not cleaned or emptied until the axle is overhauled. By adding a ¼-in. drilled hole and a tapped-in plug to this case, periodical cleaning and draining is readily done, in consequence of which the life of the gears and bearings is extended.

The filling hole should also be pro-

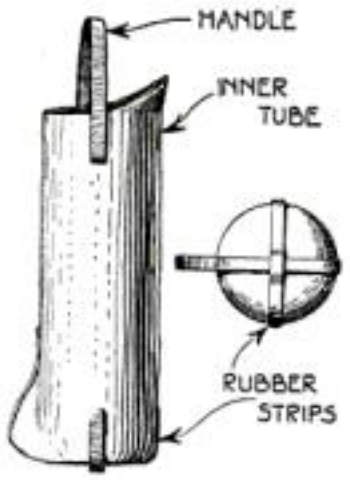
vided with an elbow connection, such as is obtainable at plumbing supply houses, to facilitate filling with oil.

The differential housing contains 8-in. gears, their bearings, and 2 quite soft babbitt thrust-bearings in addition to a ball thrust and roller radial bearing on the driving pinion. These parts rapidly contaminate the oil with much metallic grindings or slivers that cut the bearings rapidly, especially the babbitt, and throw the gear teeth out of alinement.

By draining the case, flushing with kerosene, and refilling every six months with fresh oil, the life of the axle is doubled.—G. A. LUERS.

Another Use for Old Inner Tubes

AN emergency water-bucket can be made from an 18-in. piece of a discarded inner tube; the 4½- or 5-in. sizes are preferable. If possible, use the place where the tube has been set together as the top of the bucket. The lower 3 in. is slit in four places, then turned under and cut so that the edges fit perfectly and form a nearly flat bottom.



A side and bottom view of the bucket

Now treat these edges as you would a cut in an inner tube when about to repair it; while the cement is drying, cut two 7 by 1 in. strips of patching material and apply them over the edges. Also cut two 12-in. strips 1 in. wide. Apply a thin coat of cement to the gummed side of one, starting 2 in. from the one end and stopping 2 in. from the other. When sufficiently dry, press the two 12-in. strips together. They form the handle and are attached to the upper end of the bucket by cementing the tube between the loose ends.

To make pouring easy, a lip should be cut on the concave side of the tube, and if desirable one of the strips at the bottom can be cut 10 in. long and attached. It also aids in pouring. A bucket 15 by 5 in. expands with the weight of water enough to hold ½ gal. with ease.

How to Make a Drill-Press for the Bench

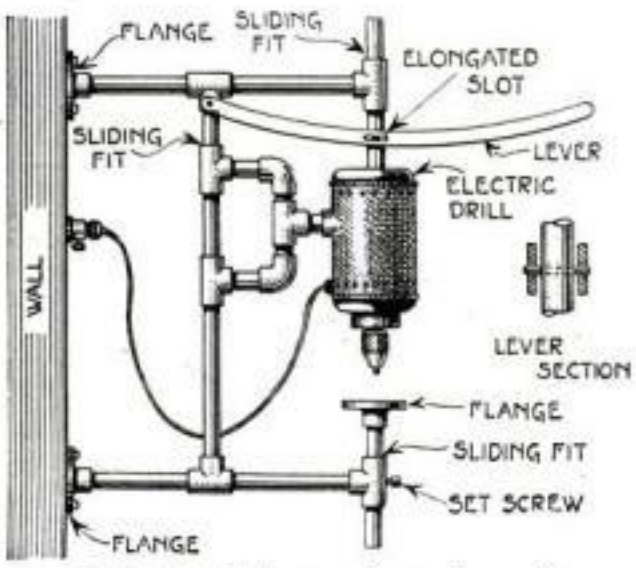
VARIOUS pieces of wrought-iron pipe and pipe-fittings as shown provide, in conjunction with an electric hand drill, a substantial bench type of drill-press from which the hand drill can be removed readily when desired.

This will apply to practically any type of electric drill with a detachable or screwed handle. With a drill of the

rigid-handle type a bolting fixture to attach to the handle can be made when desired. This drill fixture consists mainly of 3 pipe flanges, 2 elbows, and 5 "tees" joined with screwed sections of pipe of a size corresponding to the attachments used.

Two pipe flanges secured to the side wall are the supports. A third flange screwed to a section of pipe is a removable table.

The sliding "tees" on the vertical pipe and the vertical attachment above

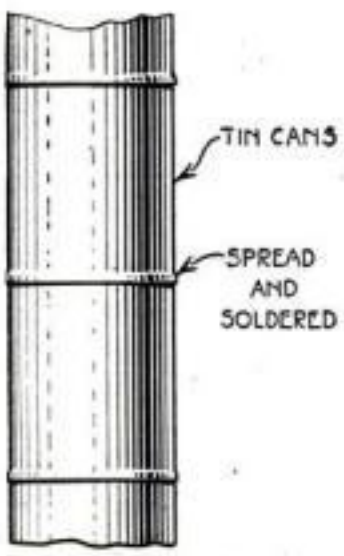


Build this drill-press from pieces of pipe-fittings and an electric drill

the drill prevent lateral movement. A simple lever, which increases the pressure on the drill above that applied to the end, is the means of feeding the drill point into the work. This attachment affords the maximum usefulness of the drill with only a slight expenditure for material and the time necessary to assemble this.—G. A. LUERS.

Tin Can Rain-Pipes to Save Money

VERY good rain-pipes or leaders can be made of tin cans. The first step is to remove the top and the bottom of each can. The solder can be melted away by putting the cans on a hot stove. After the tops and bottoms have been removed one end of each can is expanded slightly so as to receive the end of the next can. The cans are then soldered together, a little extra solder being applied to the joint at the side which may have become weakened during the melting away of the top and bottom. As each can is soldered to the other it is given a coat of paint inside and out. In this way a very durable rain-pipe is formed that answers every purpose required. — S. LEONARD BASTIN.

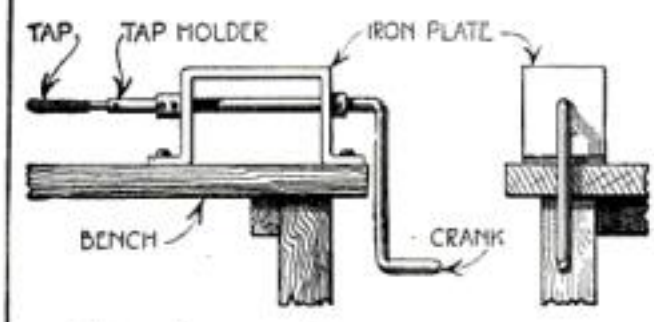


Empty tin cans can be economically used for making

Make a Tapping-Machine at Home

YOU don't have to purchase a high-priced tapping-machine if you adopt the idea shown in the accompanying sketch.

Rig up on a bench a piece of iron of the shape shown, place through this a shaft with a handle and you have a tapping-machine. The square end of the tap fits into a square hole of the



If you have much tapping to do, you will find this little machine a great help

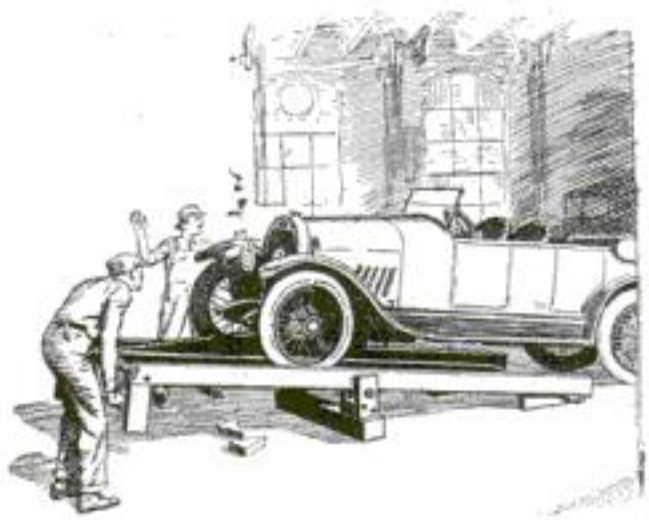
tap-holder sleeve. With this machine you can tap all sorts of work at very little cost. The sleeve that holds the tap is removable, so that different sized ends to suit different sized taps can be used.

This simple machine means added production wherever holes have to be tapped, and, what is more important, it means fewer broken taps.

A Special Stand to Facilitate Car-Repairing

IN the small repair-shop it is not always convenient or practical to have a work-pit or a permanent elevated platform for removing the automobile far enough above the floor to give free and easy access underneath. A stand that is portable and on which an automobile can be placed in an elevated position is shown in the accompanying illustration.

It consists of two longitudinal rails of wood, 10 ft. long. A center support with two pivots about 24 in. high forms a trestle on which the automobile is pulled by means of a winding-bar,



Repairs are made much easier if the automobile stands on this trestle above the floor

crank, handle, and rope, with a hook to attach to the front axle of the automobile. Two fixed blocks on the forward ends of the rails with two swing-

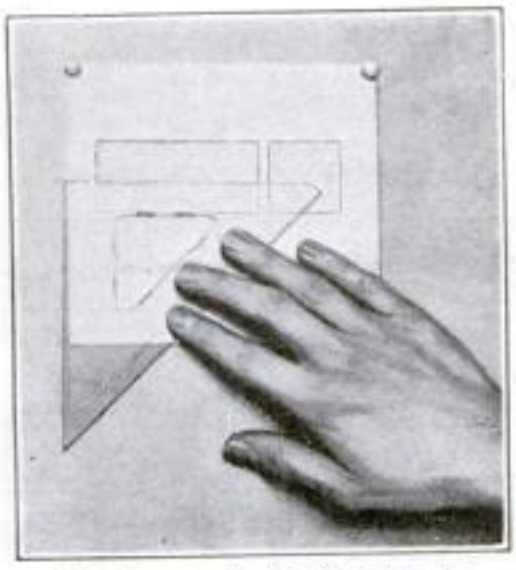
ing blocks on the rear ends rigidly support the automobile after it is pulled into place and the forward end lowered.

On account of the angle of the incline and the possibility of over-running, the winding-drum should be the means of getting the automobile on the rails. Two wedges forward nailed in place will prevent the automobile from creeping to the front. Wedges are also placed under the rear wheels. When not in use, the parts are readily disassembled and placed aside.

The Triangle in Drawing Wood Grain

MANY draftsmen, when they have occasion to show the grain of wood in their drawings, like to have the grain more uniform than they can draw it freehand. This is especially desirable in patent and other technical or conventional drawings.

The accompanying illustration shows how a triangle may be shaped to



Draftsmen who find it difficult to draw wood grain may use a triangle for the work

imitate wood grain. This can be done with an ordinary penknife. Care must be taken to leave intact about ¼ in. of each end of the triangle side to be cut (see the sketch), in order that the wavy side will be 90 degrees to the other side of the triangle, thereby leaving the angle perfectly true.

A Mixture for Hardening a Soft Grindstone

POSSESSING a grindstone which was soft and had deteriorated with age, I hardened it as follows:

Take 22 parts of rock crystal and an equal quantity of minium to 60 parts of powdered glass, 1 part arsenic, 5 parts of saltpetre and 15 parts of calcined borax.

This should then be made into a paste with water, and applied to the stone, after which soft stone will be rendered so hard as to emit sparks when struck with merely a pocket-knife.

Soft building stone, deteriorating through weathering, may also be similarly treated.—GEORGE H. HOLDEN.

A Good Way to Cool Milk Without Ice

IN the absence of ice, the common method of cooling bottles of milk and other foods is to set them so that the water flowing from the faucet falls upon the top. If it is a bottle of milk, the water spatters and but little flows down the sides of the bottle. If the

You need not drink lukewarm milk. If you have no ice-box, put the bottle under the cold-water faucet

bottle is placed so that the stream of water strikes only one side, the process of cooling is even slower.

In the accompanying illustration a scheme is shown which works well. If a small cup or butter-saucer is inverted over the top, and then placed under the faucet, the water, when turned on, will run down all sides of the cup, and, upon reaching the lower edge, flow under and directly onto the bottle. If this is tried, it will be seen that the dish and bottle may be placed in such a way that water flows down the sides uniformly.—DALE R. VAN HORN.

Eliminating Coupling Noises in Your Engine

AUTOMOBILE generators and magnetos are driven by coupling from the water-pump shaft.

When the coupling is new and all its surfaces are fitted tightly together, it works quietly and efficiently; but after being used some time, it makes a chattering or squeaking noise.

Noisy couplings can be silenced by a leather cover

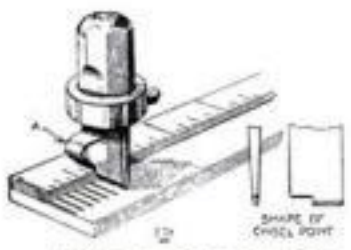
To put in a new coupling is a very difficult job, as the magneto must be removed and timed over after the new coupling is inserted.

An easy way to overcome this difficulty is to make a small leather cover to fit over the coupling. This can be clamped into place by two tin clips bent up and held by two small bolts, as shown in the illustration. A small hole is made in the side of the cover to allow the tip of an oil-can to be inserted.

Marking Metal Surfaces in an Accurate Manner

SHOULD you need to mark, or graduate any flat metal surface, look at the illustration and you will discover about as simple a method as can be found, yet accurate in every way.

Grind your chisel point to the shape shown, then fasten an ordinary scale to the portion of the piece you want marked. The rest is easy, for with the spring piece *A*, which rests on each graduation of the scale, you can lay out whatever divisions you desire. As you hit the chisel on the head with a hammer and make one mark, it becomes second nature after a little practice to move the spring part *A* along to the next indented mark on the scale.—J. W. MOORE.

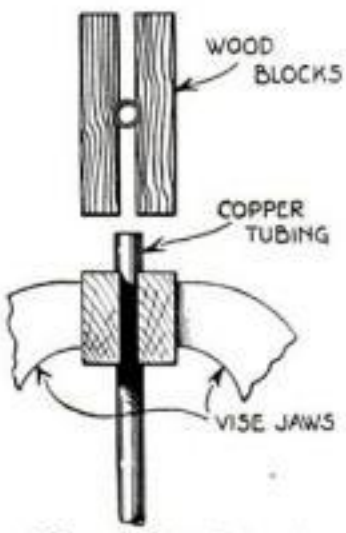


The spring permits the marker to move from one gradation to the next

How to Flare Copper and Brass Tubing

IT is always desirable to flare the ends of copper or brass tubing when fitting it for attachment to carburetors, etc. Many motorists, however, are not so fortunate as to possess any of the special tools on the market for flaring tubes and fear to damage the end of the tube by trying to do the job with ordinary tools at hand.

A very good method to flare tube ends consists in boring a block of hard wood 2 in. thick, 2 in. wide by 4 in. long, and with a 5/16-in. drill to cut the block in two with a fine saw. This forms the clamp for holding the tube between the jaws of the vise, the tube being inserted in the hole, and then allowed to project about 1/8 in. at the top.



The split block holds the tubing; the taper of a screw-head does the flaring

Now, an ordinary flathead wood screw with a body diameter permitting it to fit loosely in the tube is dropped in the end of the tube and then tapped lightly with a hammer. With each blow the screw will turn slightly. After a few taps the tube will be evenly and accurately flared.

If the tubing material is too hard to be worked by this method, it may be softened by heating it in the furnace or over a gas flame until it is red hot and then quenching it in a bucket of cold water.

An Adjustable Magneto Coupling

THE usual means provided for making magneto adjustments on most old types of gas-engines still in service—and on many present types—is by two adjustable flanges on the drive-shaft. One of these flanges has two or three bolt-holes drilled through it, and the other has corresponding elongated slots. By loosening the bolts, slightly turning the slotted flange, and tightening up again, the magneto is synchronized to give its spark at the proper instant.

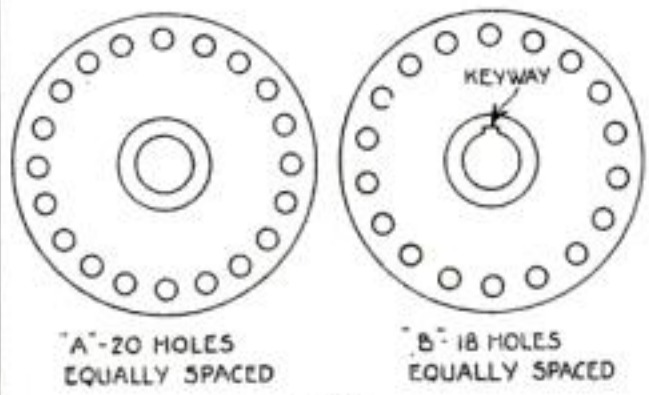


FIG. 1.

One of the adjustable flanges has twenty, the other eighteen holes, equally spaced

The disadvantages of this system more than outweigh the advantages. While it is possible to adjust exactly to any desired point, the flanges often slip while in operation as they are held in adjustment only by the grip of the nuts and boltheads.

The accompanying drawings show a flanged connection that can be adjusted near enough to any desired position for all practical purposes, and which cannot slip. Figure 1 shows two flanges drilled for two connection bolts—flange *A* has 20 holes, and flange *B* 18 holes. Figure 2 shows the manner of attaching these flanges to the magneto drive-shaft by the usual practice of pinning one flange and fitting the other with a feather key to allow for endwise adjustment.

In Fig. 3 the relation of the holes in the two flanges is shown. The flanges are placed so that the opposite holes at *A* and *A* are in alinement ready for the connecting bolts. The holes at *B* and *B* can be brought into alinement for connection by a very slight turn of either flange. A slightly greater turn will line up the next pair of holes, and so forth, so that very nearly any desired adjustment can be made.

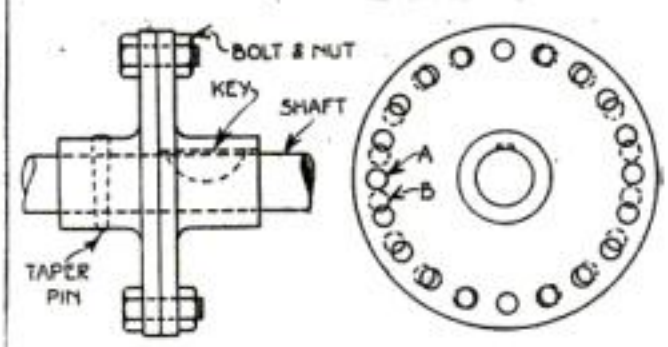


FIG. 2 FIG. 3

How the flanges are attached to the magneto shaft and the relations of the holes

To calculate the value of the smallest possible adjustment it is only necessary to find the angular difference between consecutive holes in the two flanges. Thus flange *A* (Fig. 1) has the holes spaced $360 \div 20$, or 18° apart. The holes in flange *B* are $360 \div 18$, or 20° apart. The smallest adjustment that can be made, then, is 20-18, or 2° for consecutive pairs of holes. By turning two spaces, an adjustment of 4° can be made, and so on around the whole circle by intervals of 2°. Two disks of cardboard cut out and punched as shown will illustrate the principle involved better than any amount of description.

Twenty-hole and 18-hole flanges are taken only for illustration. If closer adjustment than 2° is required, flanges with larger numbers of holes can be used, the only limit being convenience in the diameter of the flanges.

For a 3-bolt connection, the numbers of holes in the two flanges must be consecutive multiples of three. In general, if the number of bolts desired be represented by b, the number of holes in the two flanges will be $b \times n$ and $b(n+1)$, where n is any whole number selected for convenience. Also the smallest angular adjustment possible for given values of b and n will be

$$a = \frac{360}{bn} - \frac{360}{b(n+1)}$$

which simplifies to the form

$$a = \frac{360}{bn\,(n+1)}.$$

Luminous Minnows Made at Home

AS is well known, the "glowing lure" is one of the deadliest forms of artificial minnows that one uses on bass and other fish. These phosphorescent baits are used at night, for it is from six o'clock in the evening to very near midnight that the bass are striking the lure at the best. This is accounted for by the fact that during the hot days of summer the fish feed at night. The glowing lure in the water is seen and on the impulse of the moment are seized by the fish.

The knowledge of how to color and make artificial minnows glow at the same time is known to comparatively few. If the following directions are pursued, no trouble will be had in producing minnows equal to the best on the market. Four colors with the glowing combination are given, namely, orange, green, blue, and white.

To produce the orange coloration with the glow to it, take 46 parts of the best spar varnish, and mix with it 17.5 parts of prepared barium sulphate; add one part prepared Indian yellow; also 1.5 parts prepared madder lake, and 38 parts of luminous calcium sulphide. This gives excellent results. For green take 48 parts of the best

spar varnish; add 10.2 parts prepared barium sulphate. Add 8 parts green chromic oxide, and add 34 parts luminous calcium sulphide. For blue take 42 parts of spar varnish, 10.2 parts prepared barium sulphate; add 6.4 parts ultramarine blue; add 5.4 parts of cobalt blue; add 4 parts luminous calcium sulphide. For white, use silica and whiting, and with this mix in a sufficient amount of spar varnish; then add a goodly portion of luminous calcium sulphide. It is a good idea to give the minnows several coats of the paint as this gives a good coating. Old minnows can be sandpapered down and treated so that they appear like new.—ROBERT PAGE LINCOLN.

To Successfully Photograph a Blueprint

EVERY one who has tried to photograph a blueprint is familiar with the unsatisfactory results that are obtained by the usual apparatus, regardless of the detail in the original. The following method will be of interest, as remarkable results can be obtained.

A red ray-filter should be used in the camera and the exposure made on a plate that is sensitive to red light. Precautions must be taken in developing, as the ordinary dark-room lamp will ruin the red-sensitive plate. Accordingly, this must be done in darkness or with the aid of a special color-screen on the lamp. When the red-

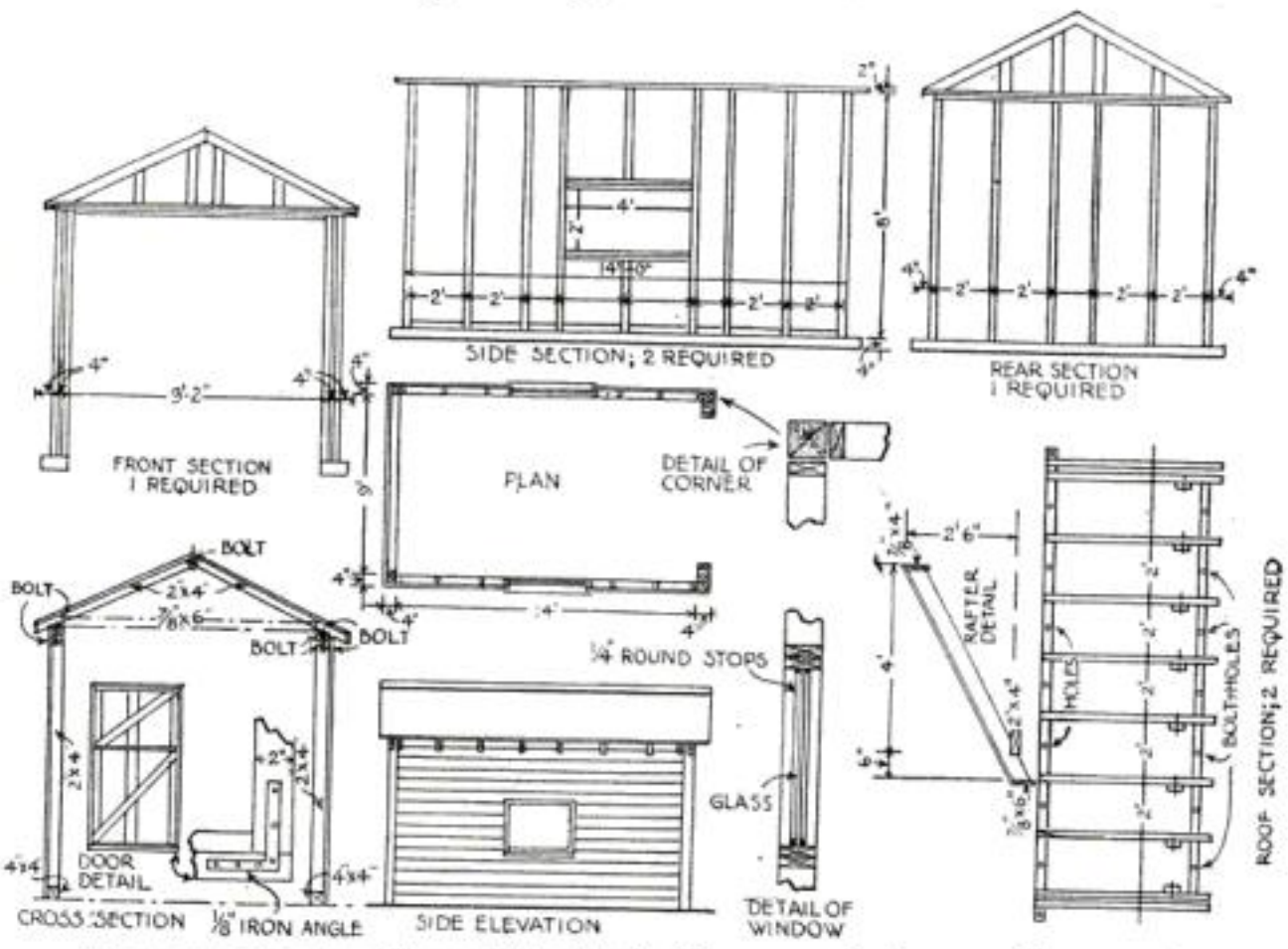
Blueprints can be photographed by using a red ray-filter and a red-sensitive plate

sensitive plates are bought, it is easy to obtain the proper lamp-screen of a complementary shade of green. When such is available, it is safe to perform the development by this green light as no ruinous effect will be produced upon the special plate. Care must be used, however, to obtain the shade of green that is exactly complementary to the red-sensitive plate that is used. After a certain amount of practice one will find no difficulty in developing in darkness.

By this simple method it is possible to make from even weak blueprints clear reproductions that actually resemble engravings in regard to detail.

Make Your Own Sectional Garage

By George M. Peterson



If you own an automobile and intend to build a garage for it, you will save part of the cost by building it in accordance with these drawings and specifications

THE illustrations herewith show a very easily built sectional garage which will be appreciated by those who have tried to get a contractor to build one for less than two or three hundred dollars.

The drawings give all of the information to frame this building, but the exterior sheathing has been omitted purposely. The garage may be covered with shiplap siding, lap siding, corrugated iron, or slater's felt, but the most desirable materials would be either corrugated-iron siding and roof, or shiplap sides and a prepared roof. Corrugated iron may be nailed directly to the studs and rafters, but for prepared roofing the roof will have to be covered with boards and the roofing placed upon them. The shiplap siding, if used, may also be applied directly to the studs.

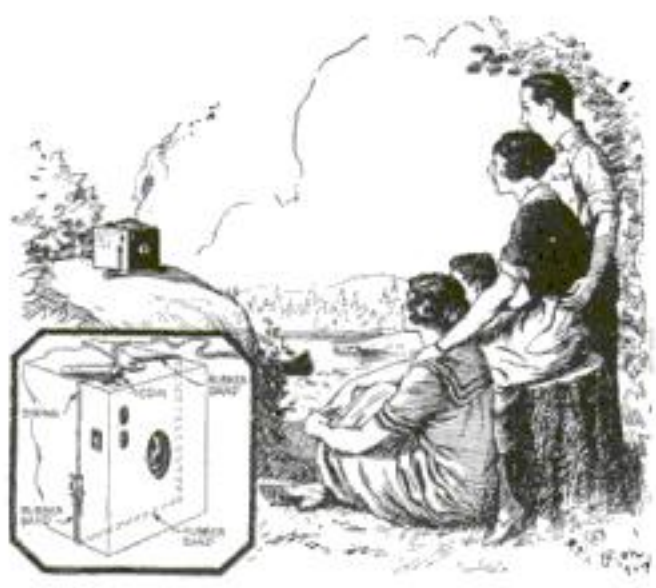
The side elevation shown in the sketch shows lap siding and a prepared roofing which makes a garage fit for any location.

A Simple Automatic Camera "Snapper" for All

WHEN a snapshot is made of a group, some one has always to be omitted from the group in order that he may operate the camera. The following arrangement makes it possible to include every member of the party without pulling a string.

The camera is prepared as follows: A piece of string is tied to the lever of the shutter release, and slipped over the camera handle or some convenient projection, thus holding the lever up securely. Then a rubber band is slipped over the lever in such a manner that it pulls downward on the lever. The band is stretched around the camera and fastened in the same manner as the string to the lever of the shutter release.

A coin is placed under the string to protect the camera surface, and the camera is now ready to be placed on some convenient object, such as a stone, post, etc., and focussed on the group. A lighted cigarette or a piece of punk is then placed on the string in such a manner that as it burns away it will burn the string. This gives the person preparing the camera sufficient time to take his position in the group before the shutter is released.



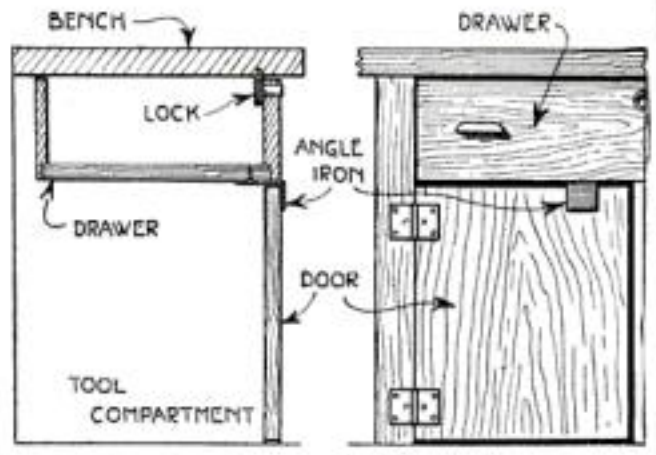
When the fire of the cigarette reaches the string, it will release the shutter

When the string burns through, the downward pull by the rubber band snaps the shutter.—GEORGE FREDERICK.

Locking Tool Compartment with Drawer Lock

IT is frequently desirable to provide a compartment under the workbench for tools and equipment too large for the bench drawer.

When this is done and it is desired to lock the compartment for safeguarding the tools, a method that does not involve the purchase and installation



When the drawer is locked, it automatically locks the tool compartment

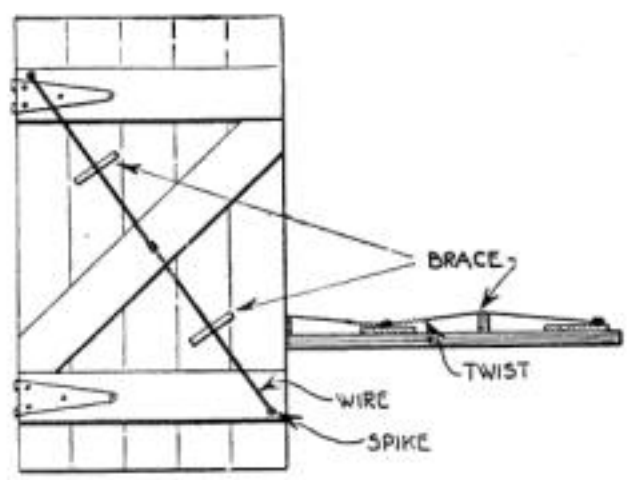
of a special or extra lock consists of having an extended metal plate attached to the under side of the drawer that will butt against the compartment door as is shown in the illustration. The door can be swung on hinges to open to one side, or the hinges can be placed next to the floor and the door swung down.

With this method only the one key and lock are required.—G. A. LUERS.

How to Repair that Sagging Garage Door

GARAGE doors have a habit of sagging after a time, making it difficult to close them properly or else necessitating their removal and planing off the bottom. Unless the door is small or exceptionally well made, planing the bottom affords only temporary relief.

An easy way to effect a permanent cure for this trouble is to drive two spikes in opposite corners of the door as shown and connect them with a few



Supported by the tension wire, the garage door will hang without sagging from its hinges

lengths of strong wire. Place two blocks of wood under the wire, forcing it out a few inches from the door. Take a third spike and insert it between the strands of wire and twist the wire with

the spike This will act as a turnbuckle and draw the bottom of the door up. When sufficient clearance is obtained, drive the center spike into the door and you have a permanent repair. In cases where the door has sagged to a great extent, it is better to give the wire only a few turns every day until proper clearance is obtained.

Carrying Excess Luggage on the Automobile

HERE is a simple method for carrying extra suitcases or other baggage on an automobile when equipment is not provided for the purpose.

On the front end of the running-board six small strap loops may be fastened by wood screws. Two loops are set in at the rear edge of the board about 20 in. apart. Another two are set crosswise on the board, a convenient distance apart. This is governed

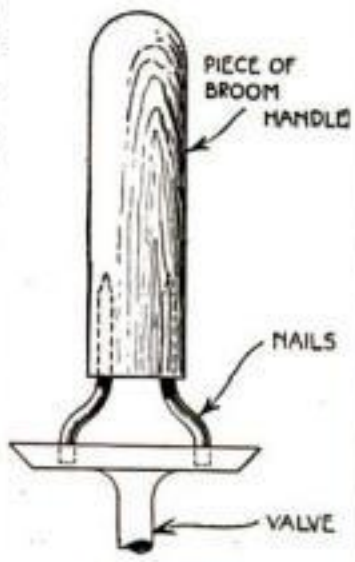
By using this method you can materially increase the carrying space of your car

by the size of the package that is being considered. The remaining two are located at the front edge of the board on its under side. The reason for this is that it permits the parcel or baggage to overhang the board. Cord or straps can be arranged to tie or strap over the bundle, the ends being threaded under the loops in a convenient manner.

A New Emergency Ford Valve-Grinder

WHERE a regular grinder tool for rotating a valve of a Ford or similar type of automobile is not available, an improvised tool can be made in a few minutes from a 5-in. section of a hoe- or broom-handle and 2 nails or 3/32-in. drill-rods.

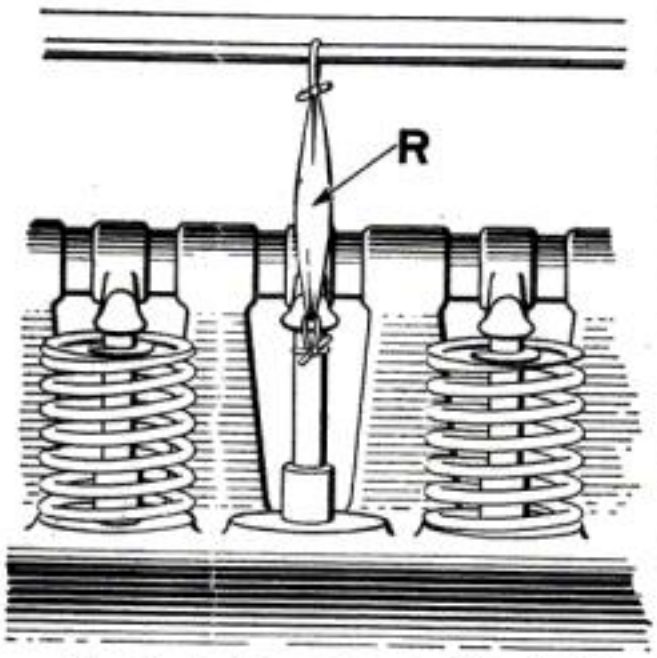
Drive the steel pins into the handle firmly, cut off evenly, and bend the points out to correspond with the holes in the valve-head. —G. A. LUERS.



In an emergency a homemade valve-grinder will do

A Substitute for a Broken Valve-Spring

DISCOVERING that the jerky action of my automobile was caused by a broken valve-spring, I immediately decided I must tie the valve-stem to prevent it from falling into the cylinder. While preparing to



For a limited time a strong rubber band will serve as a broken valve-spring

tie the stem, it occurred to me that a strong rubber band might do the work of the coil-spring, at least temporarily. The rubber band *R*, as shown in the illustration, was attached to the tie-rod directly above the cylinder block and the lower end of it was attached to the notched end of the valve-stem. To my surprise, this substitute worked perfectly and was used for nearly a week.

How to Change Blue Prints to Brown

SEVERAL years ago I was making quite a number of photographic blueprints. Hearing of a way to change them from blue to brown or sepia color, I tried it with splendid success, and the prints are still as bright and clear as when first made.

Get an ounce of tannic-acid powder or crystals. Put into a clean bottle and add just enough water to dissolve nearly all of it. There should be a little left undissolved in the bottom of the bottle; this gives a saturated solution of tannic acid.

Add one teaspoon of ammonia to one cup of cold water; pour it into a tray or other flat dish. Have the blueprint wet, then put it into the ammonia water until it is bleached to a dingy white color. Then dip it into clean cold water, and put into a tray containing the tannic-acid solution.

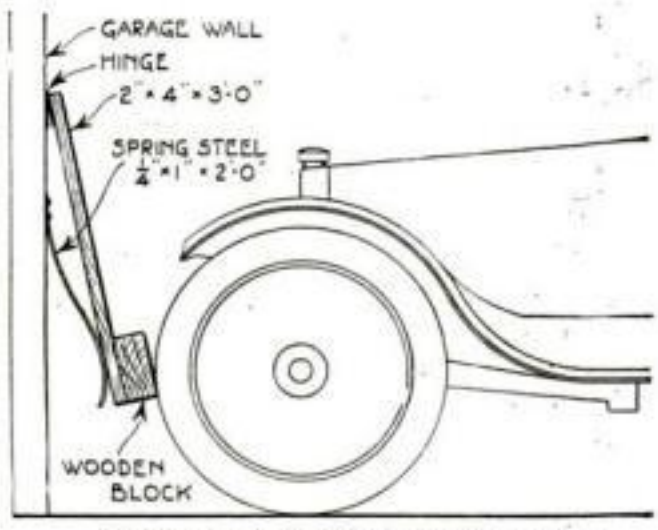
The picture will soon appear, just as on developing paper. When a deep brown in the darkest places, remove and wash well in running water.

Blueprints that have been overexposed so that they are blue all over will be all right when redeveloped this way if care is taken to remove them from the tannic-acid solution as soon as they are sharp and clear, and at once wash them well.—CORA HAMILTON.

A Bumper for the Private Garage End

CRASH! What was that? Just the hired man running the automobile into the back end of the garage. Another case of the brakes refusing to take quickly enough.

The bumper, which is easily made and will prevent such happenings, is shown in the drawing. Two 2 by 4 are cut 3 ft. long, and hinged, one to each studding, next the corner post at the end of the garage. A block of 4 by 4 of suitable length is then nailed to each lower end and a stiff flat steel spring, bent to the shape shown and drilled for nails at the upper end, is placed behind each 2 by 4 in the



The spring of this bumper must be strong to prevent injury to the recklessly driven automobile

manner shown. If tempered steel is not available, an old wagon tire cut in half will serve the purpose.

The distance from the bumper to the wall will depend upon the stiffness of the spring and the size and weight of the car, but if the lower side of the bumper rests about a foot from the end of the garage, and the springs are reasonably stiff, there will be little danger of severely jarring or starting any of the studding from the foundation.

The sharp corner of the 4 by 4, where it comes in contact with the front tires, may be rounded slightly with a drawknife.—DALE R. VAN HORN.

They Didn't Get Away with It

NO Smoking! The order was given aboard the *Leviathan* and most members of the crew observed it. A few, however, went quietly down to one of the lower holds and began to smoke. Two minutes later an officer walked in on them.

How did he find out? The men puzzled over this while they went through a round of extra duty for their offense. It seems that the fire-detecting system gave them away. It consists of pipes leading from all the different holds to the bridge. A suction fan constantly draws a supply of air up from the holds to the bridge.

Thus when the men began to smoke, a sample of it drifted before the eyes of the officer on the bridge.

This Eraser Handle Is Made of Bamboo

THE handle of this eraser-holder consists of a section of bamboo cut at the joint to insure strength. The diameter of the butt is about 1 in. The slot is cut deep to allow the use of a full length new rubber. The slot is tapered from the thickness of the rubber at the bottom to approximately

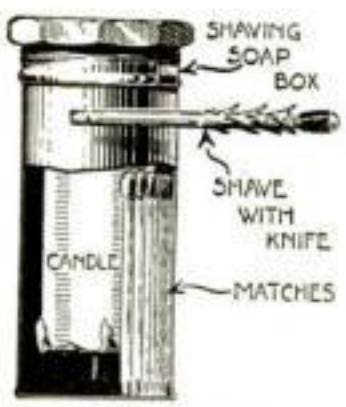
Split bamboo may be used for making an eraser holder like that shown here

one and a half the thickness of the rubber at the points. A metal band, preferably of non-oxidizing material, such as German silver, shaped like an open thimble, is provided, silver-soldered at the joint to withstand the bursting strain when in use.

Aside from the economy secured in the use of the rubber (notice the short length in the illustration), the greatest satisfaction is secured to the user by the absence of fatigue and finger-cramp whenever much erasing has to be done.—C. S. BEARDSLEY.

A Waterproof Light for Hunters and Automobilists

WHEN you are on a hunting expedition or an automobile trip, there will often be an occasion when you are in need of light. Matches can be carried in any pocket or matchbox and can be made absolutely waterproof if they are dipped in melted paraffin. In windy weather you may have some difficulty in lighting a match, but if you notch it as shown in the picture, this difficulty will practically vanish. But a match does not burn very long, nor does it give much light.



Candle and matches are kept water-proof in this box

For cases of emergency, a candle attached to the cover of a shaving-soap box and carried in the closed box to protect it, will be found very convenient. When you need a light, unscrew the cover and use it as a candlestick. Of course the candle can be used only in a place where it is protected from the wind. In the open air you will have to protect it by putting it inside one of the old-fashioned mica lamp-chimneys open at the bottom.—WILLIAM LORENCE.

Building a Simple Charging Panel

By Robert A. Chandler

THE panel described here will be found very useful for a small garage or for private use. It is easily made and portable, but the electrical fittings must be bought from a reliable house so as to cover underwriters' requirements. This apparatus cannot be used on alternating current.

Every public garage should have a charging panel. You can easily build one like that shown here

Provide the following equipment before starting:

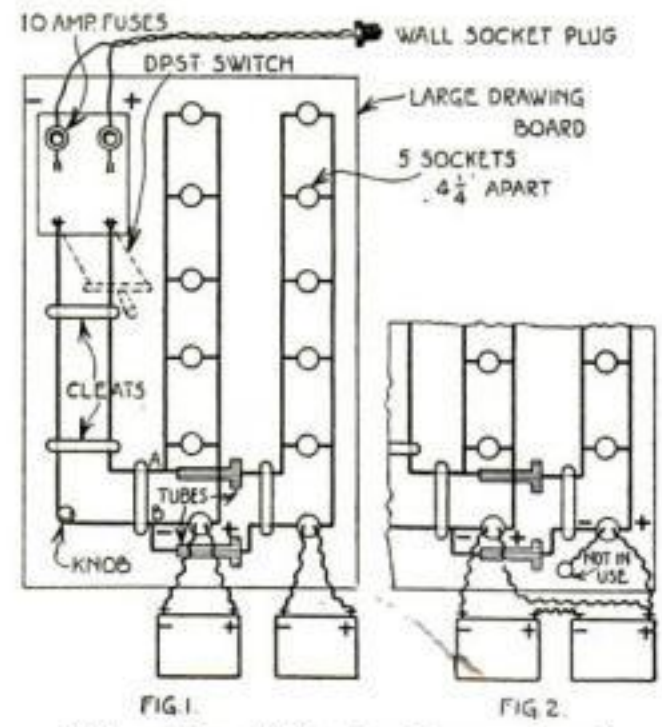
1 drawing-board, 16 by 32 in. or larger
14-ft. No. 14 rubber-covered wire
1 fuse-block (plug type) and switch (double pole, single throw, 125 volts, 25 amp.)
1 self-closing box for same, with 4 bushings
4 or more plug fuses, 10 amp. each
4 porcelain cleats
1 porcelain knob
2 porcelain tubes, 4 in.
12 lamp sockets
2 connector plugs for flexible cables
2 lengths of flexible cable, one long enough to reach from lamp socket to panel, the other to battery on automobile
10 carbon lamps, 100 watts each (provided by the electric-light company)
Asbestos card or paint, as desired
37 screws, rubber tape, friction tape, soldering apparatus.

If a drawing-board 16 by 32 in. is available, it will do, but it is slightly small. If one is to be made, have it at least 18 by 24 in. This should be painted a dead black with lampblack and shellac, as it makes it less trying on the eyes. White paint makes a neater appearance, but white enamel gives too great a glare. Some electricians use a thin sheet of asbestos card over the whole surface, as it diminishes the fire risk, but this is not required by the underwriters. If the board is not neat enough, it may be sandpapered with No. 00 grade and finished with varnish or shellac.

Set the fuses next the line, and the switch so that if it falls (due to looseness of the joints) it will not close and cause trouble. It must be completely covered by a metallic box which closes by its own weight or by a spring. Where the wires enter and leave, the holes must be bushed. This is to protect the insulation.

Either weatherproof or rubber-covered wire must be used. As the lamps give off considerable heat the weatherproof is best, but the underwriters require rubber-covered wires when they are exposed to acid fumes. If the panel is to be used in a private garage and only occasionally, the weatherproof will pass inspection, but in a public garage none but rubber-covered wire will be allowed. Size No. 14 is the smallest permissible. As it will carry 15 amp. safely, there is ample margin. Where a wire ends at a lamp socket or switch, the end should be turned over to form an eye for fastening.

The lamp sockets are of the standard type for house lighting. If a 100-watt lamp (32 candlepower, carbon filament) is screwed into one, it allows about 1 amp. of current to pass. If only ½ amp. is required, an ordinary 16-candlepower (50-watt, carbon filament) lamp can be used, but this is seldom required, as a variation of 1 amp. is sufficiently close for this work. Be sure to use carbon lamps, as they permit more current to pass. More sockets may be added if a greater charging capacity is required. But not more than 15 can be supplied by a No. 14 wire. No. 12



The wiring of the charging panel and the proper way of connecting the batteries are illustrated by this diagram

wire may be used with 20 sockets for supplying 20 amp. of current.

Note that the wires must nowhere come closer together than 2½ in. The cleats keep them at this distance and ½ in. away from the board. Where one passes under another, a porcelain tube must be used. Tape the ends securely so that the tube will not shift.

The two cables used to supply current to the panel and to connect with the battery should be of the twin type, carrying two wires, and heavy enough to stand rough usage. Twin lamp cord is too light. Each should be provided with a connector plug so that the panel may be moved from place to place as required.

Having finished the board to your satisfaction, notify the electric-light company and make requisition for the lamps.

Having chosen the lamp socket to supply your panel, follow the line back and note the size fuse on that branch. This is usually 6 amp. If 10 amp. are to be used at the board, and some of the lights burn as well, the fuse will have to be large enough to cover this. Do not use more than 15 amp. on the line, as that is all the wire should carry. After charging, replace the 6-amp. fuses.

Find the Wire Polarity

It will now be necessary to find the polarity of the wires that run to the battery. Provide a tumbler of water and drop a half-teaspoonful of electrolyte into it from the battery, using the hydrometer syringe. This is to make it a better conductor. A pinch of table-salt may be used if it is inconvenient to use acid. Now place the two wires in the solution, keeping the ends slightly separated. The one which gives off bubbles is the *negative* and should be left unmarked. The other is the positive, which should be marked in some unmistakable manner—by a piece of tape, string, or a knot tied in it. The polarity should be tested every time the panel is connected to a different socket.

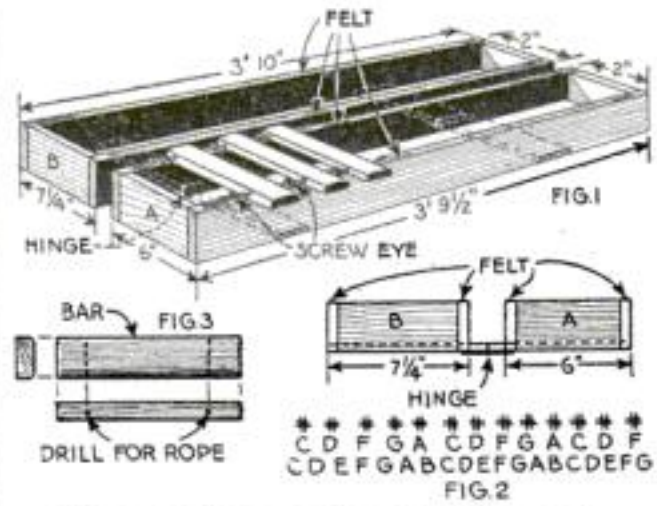
For charging, connect positive of panel with positive of battery and negative with negative. The charging rate is given on the side of battery, as, "Start 15 amp., finish 5 amp.," or whatever it may be. This is obtained by screwing in as many lamps as required. Those that are passing current indicate it by lighting up, so that we have an easy way of knowing the rate at which the battery is charging. If the cells bubble over, we unscrew a lamp at a time and reduce the charge.

If two or more batteries are to be charged simultaneously, they must be connected in series (positive or negative). Then the positive of the end battery is connected with the positive of the panel, and the negative of the battery at the other end is attached to the negative of the panel. If the two are to be charged at different rates, the two banks of lamps can be connected with them as shown in Fig. 2.

Make a Xylophone in Your Own Home

IF you like xylophone music, it will pay you to make such an instrument in view of their present high cost. The frames must be made first. Use hardwood strips ⅝ in. thick and cut to the dimensions given in the detail diagram. One of the frames is 2½ in. high, the other 3½ in. Saw the ends at an angle so they may be mitered. Glue a double layer of thick felt lengthwise along the top edges to within 2 in. of each end. The bars are to rest on the felt.

These bars are made from strips of hardwood flooring. Saw off the grooves and tongues from each side of



Make a xylophone for yourself according to directions. Your neighbors will appreciate it

the strips and plane them smooth. Bevel the two top edges slightly and round them off with sandpaper. No specific directions can be given for the length of the bars for the various notes as it differs with the kind of wood used. The length of each bar is to be determined by trial. Cut several pieces from ½ ft. to 1½ ft. in length and lay them on the felt on one of the frames. By striking them with the handle of a screwdriver you can determine their pitch, comparing each tone with the corresponding note on the piano. If the tone of the bar is not entirely true, it must be tuned. Planing off the ends raises the tone. If the tone is too high, tune it for the next higher tone on the piano. Label each bar properly tuned with the note it represents. Cut enough of these strips or bars for the 32 notes of the instrument, which has a range of two and a half octaves. Figure 2 shows a suitable scale of notes for such an instrument. The high G corresponds in pitch with the highest G on the piano.

After all the bars corresponding in tone with the white notes on the piano are cut, lay them on the lower frame in their consecutive order, space them evenly, and arrange them so that the distance between the notes will be the same on the whole frame. Now, with a long straight edge, draw a line along all the bars, above the middle of the pieces composing the frame. Make a punch mark in the frame halfway between the bars and insert a screw-eye in each hole capable of holding a ¼-in. rope. Remove the bars and drill holes through each bar to correspond with the lines marked on them. Replace the bars and fastening a piece of ¼-in. rope to one end of the frame with a couple of staples, string the rope through each bar and screw-eye.

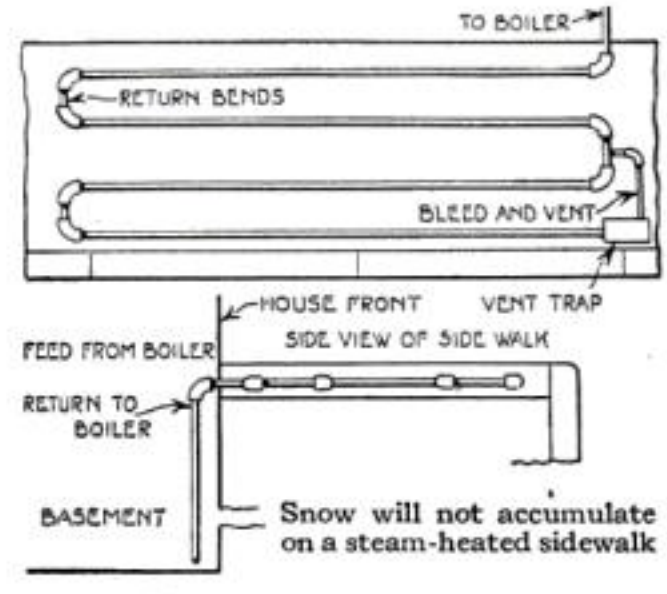
At the end of the frame turn to the other side and fasten the bars on the other side in the same manner. Next set the other frame side by side with the one already completed, place on it the bars corresponding with the black notes on the piano in their respective order, and fasten them just as the bars representing the white notes were fastened. Then turn both frames face down and connect them by strips, ½ in. by 2 in., so that the bars of the second frame overlap but don't touch those of the first. Cut these strips with the saw halfway between the two frames and connect them by hinges. The instrument can then be folded and is easier to carry.

Varnish all woodwork, which will improve the appearance and durability of the instrument. Mallets for playing the instrument may be made by drilling holes in two wooden parlor-croquet balls and inserting a wooden handle in each. If you wish, you may obtain hard rubber mallets intended for this purpose at any near-by music-store.—CARL CHASE.

Steam-Heated Sidewalks Will Clear Snow Away

DURING the winter season, especially when there is heavy snowfall, a steam-heated sidewalk will save a great deal of time, labor, and expense which would otherwise be necessary for removing the snow.

As shown in the illustration, the steam-pipes are laid in the cinder-bed



Snow will not accumulate on a steam-heated sidewalk

of the sidewalk before the concrete is put on. The more coils, the better it will be. The pipes should be of galvanized iron.

The bleed and vent traps do not necessarily have to be in the sidewalk, but may be placed in the basement, connected with the pipes by the bleed-pipe, and provided with an air-valve to release the condensed water and air.

Correcting a Defect in an Automobile

AUTOMOBILE owners may gain a valuable suggestion from the description of the method I used in correcting a defect in the coupling of an automobile.

The car was equipped with plain disk couplings with leather insert, which connected the generator with the pump on one hand and the magneto on the other. We found it practically impossible to keep the back lash out. Thereupon we took two silent chain-gear wheels and cut these in two, placing

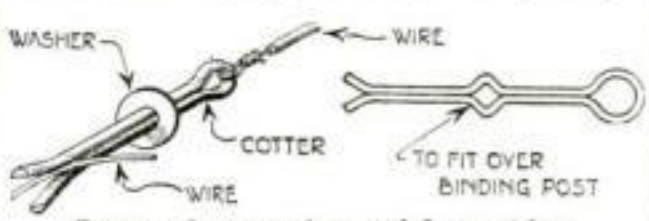
Silent chain-gear wheels, sawed in half and coupled by chain, corrected a defective coupling

each half on its respective shaft and placed the chain around the two halves. The chain, after being connected, holds the two halves of the wheel together and acts (to some extent) as a universal joint, at the same time making a much finer adjustment for the timing of the magneto.

We have tried these couplings out for five thousand miles, and there is not the least bit of the lost motion that is usually to be found in other couplings.—H. R. SPENCER.

Electric Wires Connected with a Cotter-Pin

WHERE electrical connections must be made and remade in wires carrying relatively small currents, the ends of the wires may be slipped through the loop or eye of the cotter-pin—soldered and twisted to make good contact, and taped. Wire ends thus equipped may be quickly



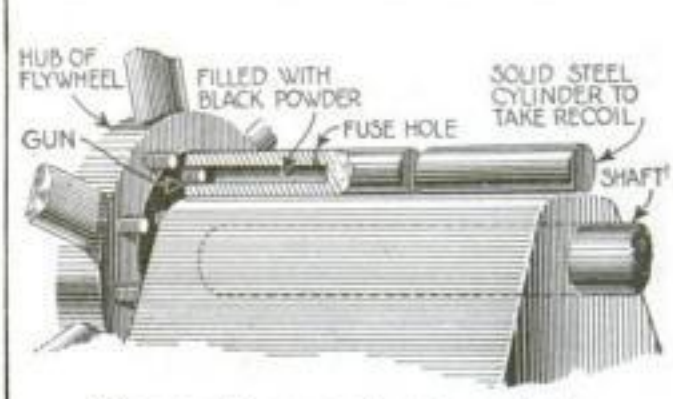
Cotter-pins may be used for making wire connections

attached to other wires, to binding-posts, or to each other by simply slipping the fork of the cotter-pin over the wire and sliding the washer forward to lock it.

Wire ends so equipped may be used and reused without becoming frayed.

Gunpowder for Removing Heavy Bolts

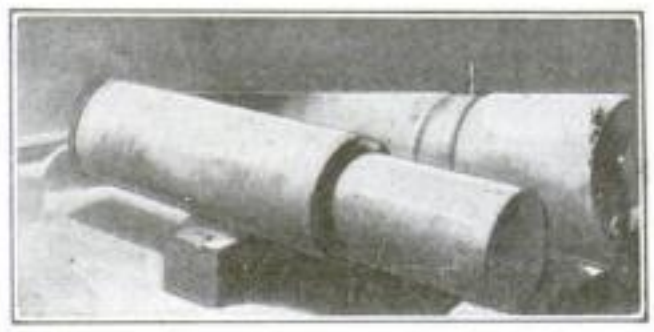
RECENTLY a large manufacturing concern had occasion to dismantle a heavy gas-engine, having a flywheel some 30 ft. in diameter. The tearing down of the engines proceeded without unusual difficulty until the flywheel was reached. The sections of which the wheel was formed were separated, after some little difficulty, by heating the large keys which joined them until they expanded sufficiently to be driven out. But the real trouble was found in removing the hub-bolts of the wheel. These were 2½ in. in diameter, and from 12 to 18 in. long. Many years of operation in a damp and dusty place had so cemented the bolts in place that they resisted the best efforts of a 30-ton jack which was provided for the purpose. After some delay, a 100-ton jack was obtained, and further attempts were made to dislodge some of the bolts by the use of the heavier jack in connection with the 10-ton electric crane which formed part of the power-house equipment. Again failure resulted; a few of the bolts yielded, but the longer ones in the inner circle around the hub refused to budge.



The gun for removing heavy bolts and the recoil cylinder are here shown in working position

In the extremity, some bright ex-service man remembered the damage which can be done by the mortar type of artillery, and proceeded to build a gun. Obtaining a piece of the shafting used in a similar engine, about 10 in. in diameter and 4 ft. long, he bored out a hole slightly larger than the diameter of the bolts and extending some distance inward from the center of one end of the steel cylinder.

Near the end of the large hole, a small hole for a fuse was drilled in from the side. In one of the illustrations a sliver of wood is set upright in this fuse hole to show its position.

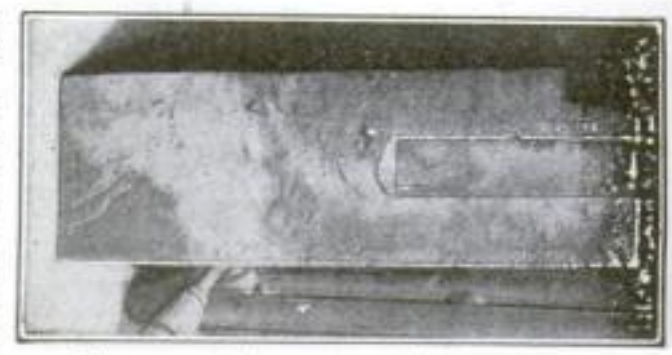


The further of the two cylinders is the gun which blew out the bolts; the nearer cylinder provided backing to take the recoil

The other piece of shafting shown in this picture was set up behind the gun to take the recoil, and the gun was set with its muzzle directly against one of the bolts to be blown out.

In the first attempts the gun was loaded with dynamite, and a small section of shafting was used as a plug or "solid shot." The result was that the first gun used was blown in two. One of the illustrations shows the remains of this exploded gun. (The fuse hole does not show, as it was in the half which was blown off.) It was also found that the use of the steel plug was impracticable, as it damaged the metal of the flywheel.

Using the gun shown with a charge of black powder and no plug or shot whatever, all the bolts in the flywheel hub were finally loosened to a point where they could be pulled out by the heavy jack; a few of the bolts were blown clear out by the force of the explosion. A few days' work, guided by a little military experience, thus avoided the tedious and highly expensive alternative of drilling out the large bolts.



The use of dynamite in this gun blew it in two; to avoid this it was found necessary to use, instead, ordinary black powder

You Can Render Drawing-Paper Transparent

A CONVENIENT method for rendering ordinary drawing-paper transparent for the purpose of making tracings, and of removing its transparency so as to restore its former appearance when the drawing is completed, consists in dissolving a given quantity of castor-oil in one, two, or three volumes of absolute alcohol, according to the thickness of the paper; and applying it to the sheet by means of a sponge.

The alcohol evaporates in a few minutes, and the tracing-paper is dry and ready for immediate use. The drawing or tracing can be made either with lead-pencil or india ink and the oil removed from the paper by immersing it in absolute alcohol, thus restoring its original appearance and opacity.

The alcohol employed in removing the first oil is of course preserved for diluting the oil used in preparing the next sheet.

The solutions should be kept in well-stoppered bottles to insure cleanliness.

How to Straighten a Bent Connecting-Rod

SOME time ago a serious accident in the engine-room of one of our local cotton-mills caused the stoppage of the machinery and temporarily made the three thousand employees of the mills idle. The crosshead pin became obstructed and this caused the buckling of a large steel connecting-rod of great weight. The rod was 18 ft. long and near its middle, where it was bent, about 10 in. thick. The straightening of the connecting-rod by machinery was out of the question because the mills had no machinery of adequate size and power to do the work.

In the yard of the factory we built a forge from bricks, leaving a gap at one end to admit the connecting-rod. We built a great fire, loaded the connecting-rod on a truck, rolled it to the forge, and placed it with the bent part in the fire.

Four hours later we took the rod out of the forge, placed one end of the rod on the ground, and lifted the other end with our yard derrick about 6 ft. from the ground. The raised end of the

Heated at the bend, the connecting-rod was dropped on the ties

connecting-rod was held by a grass rope close to the end. We placed two railroad crossties on the ground beneath the bend and with a steel hook slipped the rope off the end.

Three falls of the rod, which had to be reheated twice, straightened the bend and, as there was fortunately no torsion, the connecting-rod functioned properly when the engine was started next morning.—J. EDGAR MITCHELL.

Temporary Patch for a Torn Automobile Top

HERE is a good method for mending a torn automobile top. Sew the torn edges of the tear together with stout thread. Then take several strips of surgeon's tape and lay them over the joints, pressing the tape down solidly and warming it by the heat of the hand.

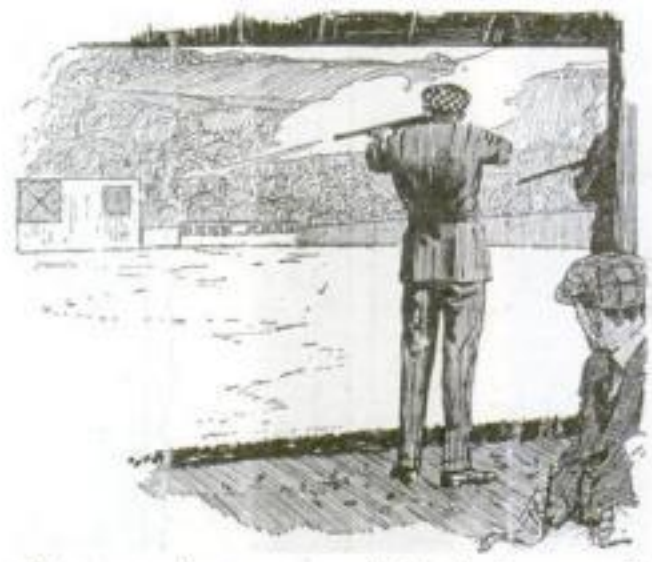
When the tape is firmly stuck to the top, give it a couple of coats of shellac and allow it to dry thoroughly.

Lastly, give the tape a coat of quick-drying paint, the color of the top, and the repair is completed.

An Electrical Automatic Recording Target

By Clifford A. Butterworth

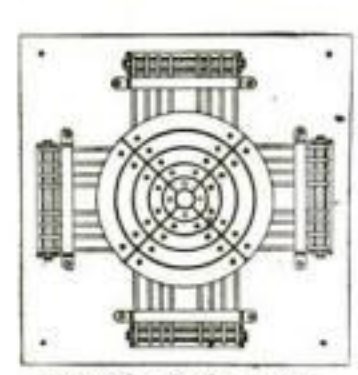
THE construction of an electrical automatic recording target for a rifle-range is detailed in the accompanying illustrations. In operation, the spot where a bullet strikes is instantly indicated by the lighting of a lamp in a corresponding position on a signal-board, making it easy to correct the aim and keep account of the score at ranges at which the target cannot be easily seen.



Shoot at the target and electric lamps will signal automatically where your bullet struck

The target is composed of five rings, each of which is divided into four sections. Each section is fastened to two arms which swing on a pivot. The section is normally held out by a spring, but when a bullet strikes, it swings back under the impact, pushing in a switch plunger which closes the contacts on the back of the target panel, lighting a lamp on the signal-board.

As the size of a target depends entirely upon the range at which it is to be used, this is left to the constructor. The dimensions given are for a target approximately 8 in. in diameter. If the target is increased in size to any great extent, the parts must be made heavier in order to have sufficient strength.



Detail of the construction of the target is shown here

In making the target a wood panel is first built up, being made about 16 in. square. To this is bolted an iron plate of the same size, ¼ in thick. The screws that hold on the working parts can be tapped into the plate, or bolts can be used and run clear through the wood.

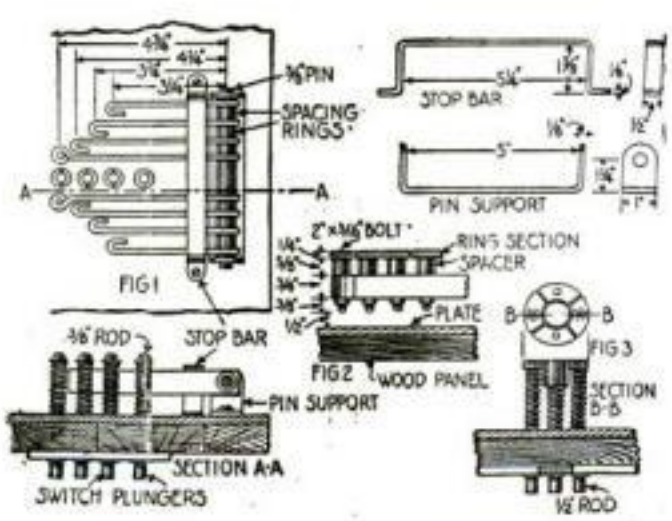
The target rings are cut from ¼-in. plate, turned to size and then cut into sections. They are drilled and countersunk for the 3/16-in. bolts that fasten them to the arms. The outside diameters of the rings are as follows: Outer ring, 8¼ in.; second ring, 6¼ in.; third ring, 4½ in.; fourth ring, 3 in.; fifth ring, 1¾ in.; bull's-eye, ¾ in.

The arms are shown in detail in Fig. 1. They are made of 3/16 by ¾ in. flat iron. They swing on a ⅜-in. pin. The spacing rings that keep them the proper distance apart are cut from ⅜-in. pipe. The switch plungers are made of ⅜-in. steel rod. The ring sections are fastened to the arms as in Fig. 2. The spacers, which are placed between the sections and the arms, can be cut from ¼-in. pipe or washers can be used. The space between the ends of the bolts and the plate must not be more than ½ in. The arrangement of the bull's-eye and the four sections around it is shown in Fig. 3. These five plungers are made of ½- instead of ⅜-in. rod.

The five small plates on the back of the panel which provide a bearing for the inner ends of the switch plungers are arranged as in Fig. 4. The holes in the panel must be large enough so that the plungers will not touch the wood, as they must work as easily as possible. The best way to do is to mark the places for the plungers on the front plate, and after boring the holes in the wood and fastening the plates on the back, drill the plunger holes through both plates at once. This will insure perfect alinement.

The arrangement of the contacts is also shown in Fig. 4, and an enlarged view of a contact strip in Fig. 5. The strip is placed so that a contact is made when the plunger has moved in about ⅛ in.

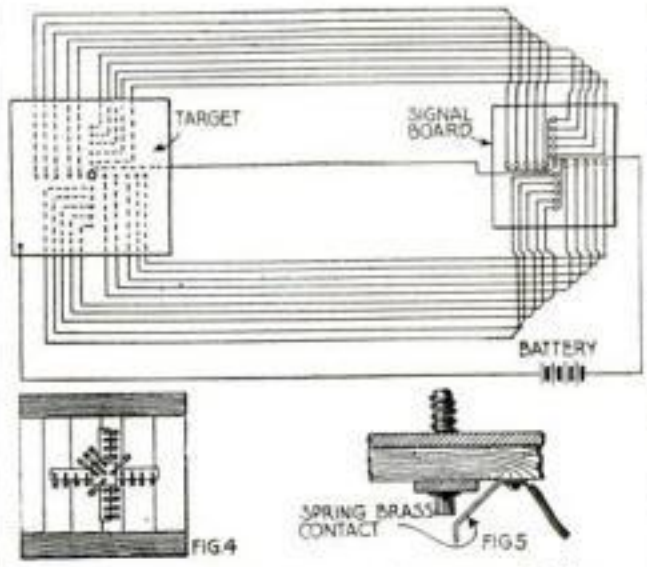
The wires from the target to the signal-board are connected as shown in the wiring diagram. A wire is run from each contact to the lamp in the corresponding position on the signal-board. One battery wire makes connection with all the lamps, and the other is connected with the plate on the target panel. Altogether there are 22 wires running back from



These cross-sections and diagrams of the different parts of the target will be of help to you in making such a target

the target. They can be bunched together like a cable and bound with tape every few feet.

The signal system can be improved by the maker if desired. For example, the wires from the target, instead of being connected directly to the lamps, could be connected to electromagnets operating small switches, so that a lamp on the signal-board, instead of only flashing an instant, would remain



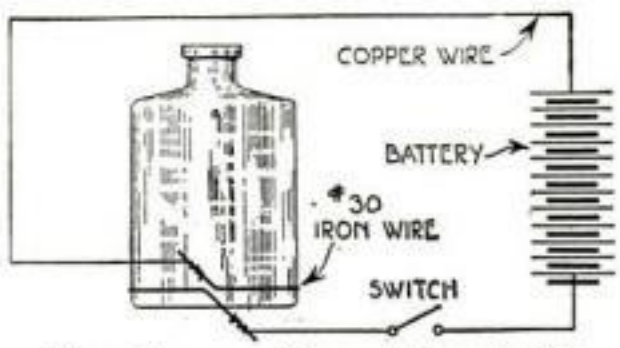
The complete wiring diagram of the target and the construction of the electric contacts are here shown

lighted until the switch was released. It would also be possible to construct an automatic recorder with electro-magnetically controlled pencils to mark the score on paper moved by clockwork.

Cutting Off the Bottom of a Bottle

IT is sometimes desirable, especially in a laboratory, to cut off the bottom of a bottle and to do so with a clean-cut fracture.

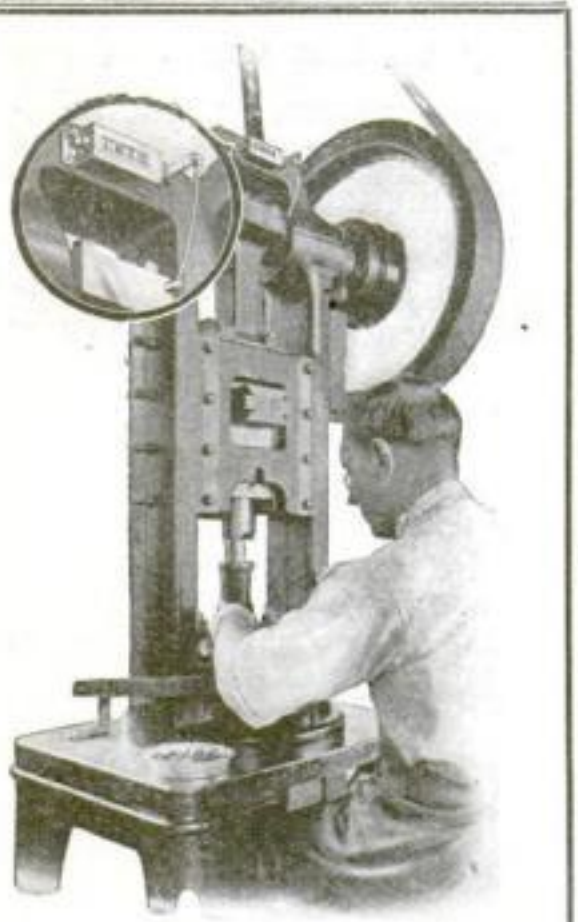
The accompanying diagram shows a very effective method. Tightly draw about the bottom of the bottle a piece of No. 30 iron wire, carrying one end to one pole of a battery and the other end to one binding-post of a knife-switch. Do not allow the ends



When the current is sent through the wire, its heat will cause the bottle to crack

to touch at the point on the glass where they cross, and draw them tightly. Connect the other binding-post of the switch and the battery with ordinary copper bell-wire.

The source of current may be a dozen dry cells, or with a suitable resistance in series, current may be taken directly from the house-lighting circuit. Upon closing the circuit, the heat in the wire causes the glass of the bottle to crack in a smooth line.



Why Some Lathe-Work Is Inaccurate

By Howard Greene

OFTEN the amateur mechanic finds that when a piece of turning is finished it is not as accurate as it should be, though the lathe may be of a good make, the tools in good order, and the actual turning carefully done. Perhaps the commonest fault found is that, in the case of a shaft or other somewhat long piece, the diameter at the tailstock end will be greater than at the headstock end. The reason will be found in the fact that the center for the tailstock end has not been properly prepared.

A center-mark is made with a center-punch, the lathe center jabbed into it, and the work proceeded with. As the work goes on, the center, finding itself in a place in which it does not fit, gradually wears itself into the metal. As the recess gets larger, the shaft becomes loose between the centers and shifts away from the tool. Not only does it shift more and more as the work proceeds and the recess becomes larger, but the nearer the tool comes to the dead center, the greater is the movement. And if the mechanic, noticing the looseness, tightens up his back center, the result will be a change in the cut unless the tightening is done between cuts.

Careful gaging will disclose inaccuracies if the work is not properly centered

The proper thing to do is to prepare a proper center in the first place. Drill a small hole in the center of the shaft; 1/16 in. is a good size for small work. Drill it far enough so that the point of the center will not reach to the bottom. Then make the seat for the dead center with a regular centering tool or a drill ground to the 60° angle of the center, or with an old center with flutes cut on it as shown in the illustration. This gives a bearing for the center that will hold the work properly, though it is always well to try between cuts and see if any shake has developed. The small hole first drilled not only protects the point of the center, which should never touch the work, but also holds a little extra supply of oil for lubrication. While the centering of the other end of the work is not so important, because there is no relative movement there between the center and the work, it is best to treat both ends the same way.

A good center and the tool for cutting one

Another cause of annoying inaccuracy in lathe-work is back-lash in the cross-slide. If the work is done with an eye wide open to this possibility, trouble can be usually avoided. For instance, if the tool has been fed in and the mechanic finds it has been advanced too far and turns the handle back a little, if he is not looking out, the result may be a backward jump until the back-lash is taken up and a consequent involuntary alteration in the adjustment occurs. The proper way, under the circumstances, is to back off the tool a little and then feed it up again so that there will always be pressure from the screw to resist the push from the tool. Watch an experienced lathe-hand and he will work this way almost invariably, constantly on his guard against trouble as a matter of fixed habit.

Do not start a job without oil at the cutting-point and then later on start the oil running. It will alter the cut. On the other hand, if you start the oil, keep it up to the end of the cut. Use the same cutting lubricant from one end of a cut to the other if accuracy is called for.

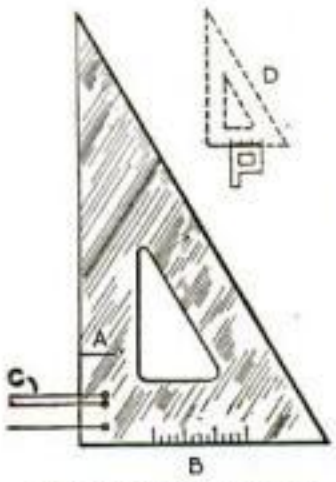
It is a common thing to use a file—smooth cut—for getting a smooth finish on a rough-turned job. This is all right in some cases, but it is bad business unless accuracy is a minor consideration. It is practically impossible to file evenly enough to avoid taking off more in one place than another, and the work will be more or less out of parallel and out of round. But if only finish is the object, it will do well enough. Never hold the file still while the work runs under it. Keep it moving, not only across the work, but lengthwise, or you will get scratches and grooves and the file will get its teeth filled up very rapidly. In r ome work a very fine finish can be obtained by using a bit of oilstone and oil on the surface.

The amateur working on the lathe should always bear in mind that accuracy is the most important thing and fine finish is of only secondary consideration.

Increasing the Usefulness of the Triangle

THE usefulness of a triangle such as is used by draftsmen may be increased by a simple method without marring it in any way. Drill 3 small holes as indicated in the accompanying drawing about ½ in. from the edge of the longer right-angle side.

When you wish to do some lettering, you can draw guide-lines by placing the point of the pencil successively into the 3 holes and drawing the lines by sliding the short side of the triangle along the edge of the T-square. Without any measuring the size of the lettering will be uniform.



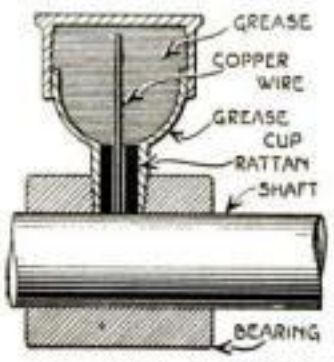
Mark your triangle thus if you do much lettering

If you mark out the proper distance, and draw a line as shown at *A*, it will help you to get uniform spacing between the lines of the lettering. The scale marked at the short edge of the rectangle will enable you to mark off the guide-points for the vertical lines of block letters as shown at *D* in the upper corner.—J. H. MOORE.

For Oiling Line-Shafting Bearings Automatically

IN small workshops where no millwright is employed, line-shafting is quite frequently neglected and allowed to go without proper lubrication. If the bearings are equipped with grease-cups, as shown in the illustration, they will run for a considerable length of time without attention.

A small length of rattan is driven into the nipple of the cup as shown. Through its center is drilled a hole of a diameter large enough to accommodate a piece of copper wire and leave a small clearance. A piece of copper wire is placed as shown, one end touching the shaft, the other protruding into the grease-cup.



Oil your bearings well and avoid trouble

The grease-cup is filled in the usual way. As the bearing warms up with the friction of the shaft's turning, the copper wire, being in contact with the shaft and a good conductor of heat, warms the hard oil in the cup enough to allow some of it to flow down to the bearing. The warmer the shaft becomes the more oil is fed to the bearing. The wire, being softer than the shaft, does not scratch or cut the shaft.

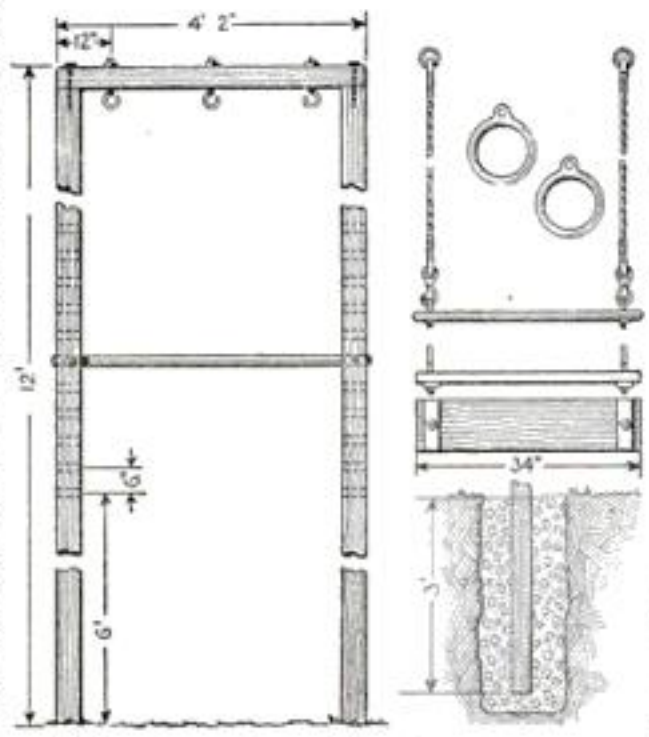
Gymnastic Apparatus for Your Yard

By Walter S. J. Thompson

THE apparatus shown in the illustration comprises the horizontal bar, flying rings, trapeze, and a child's swing, while rope-climbing can also be practised upon it.

The uprights are two scantlings 2 in. thick by 4 in. in width and 15 ft. long. The crosspiece at the top is a piece of the same material 4½ ft. long. These can be purchased in a lumber-yard.

Put the scantlings together with the 2-in. sides facing each other. Then measure up 3 ft. from one end and mark with a pencil. This length goes into the ground. Measure up 6 ft. from the 3-ft. mark and mark again. Now mark every 6 in. for a distance of 2 ft. each side of the 6-ft. mark. These are for the holes which the horizontal bar slips through. Then take a brace and bit and bore a hole 1⅝ in. in diameter in the middle of the scantling at every 6-in. mark. Then turn the scantlings so the 4-in. sides are together and in the middle of the 2-in. side on both scantlings, draw a line from the first hole to the last and bore a ¼-in. hole all the way through the scantling so it will pierce the center of every large hole. Do this till every hole is pierced. This is for the bolt that holds the horizontal bar in its place.



Why not erect a combination apparatus like this in your back yard?

Now place them on the ground 4 ft. 2 in. apart, resting on the 2-in. side. They are now ready for the crosspiece at the top. It is well to have the ground ends resting against a wall or block of wood so they will not move when the crosspiece is nailed on. Put two large hook-bolts in the crosspiece with the hook end extending from the 4-in. side, 12 in. from each end. These are for the trapeze ropes. Place another one in the center of the same side to be used for rope-climbing. Nail the crosspiece to the tops of the scantlings.

Now give the whole structure a coat of white lead and two or three coats of any color paint desired. While the paint is drying, select the spot where you wish to erect the apparatus, but be sure you have room enough for the trapeze and swing. Dig two square holes 1¼ ft. square and 3 ft. 4 in. deep. The scantlings should be in the center of the holes and there should be 4 ft. 2 in. between them.

When the paint is dry, mix the concrete. One part cement, 2 parts sand, and 3 parts stone. Mix it thinly and put 4 in. of it in the bottom of the hole, then set the scantlings in place and put the concrete around them. Keep the scantlings vertical by stays while the concrete is soft. It will take about a month for the concrete to harden, during which time the scantlings must not be touched.

A piece of oak pole 4½ ft. long and 1½ in. in diameter is best for the horizontal bar. Run the bar through the lowest hole in one scantling and through the corresponding hole in the other scantling, and if the bar is not even with the outside of each scantling, it should be sawed off so it will be. Take a bit 1¼ in. in diameter and shove it through the small hole in the scantling and bore a hole through the horizontal bar. Be sure to hold the bit horizontal or else it will not come out through the hole in the other scantling. Now purchase 2 bolts 4½ in. long: these are to slip through the small hole in the scantling and in the horizontal bar to keep it firm while it is being used.

The trapeze-bar is made from the same material as the horizontal bar, but it should be 34 in. long. Bore two holes 1½ in. from each end. Purchase two bolts like those shown. Run these through the holes and tighten the nuts. It is well to wire the bar each side of the bolt with copper wire to prevent the bar from splitting. Now purchase a piece of manila rope 14 ft. long. Cut it in two equal parts. Now buy two safety-hooks such as shown in the illustration, pass one end of the rope through and splice the rope for a distance of 6 in. Then wind it tightly with strong fishing-cord. Do the same to the other hook. The other end of the rope is passed through a ring and wound.

The seat for the swing is the same length as the trapeze-bar and about 1 in. thick by 8 to 10 in. wide. Nail two cleats, one on each side of the seat, as shown in the illustration. Bore a hole at each end for a bolt. The same kind of a bolt is used as was used on the trapeze-bar.

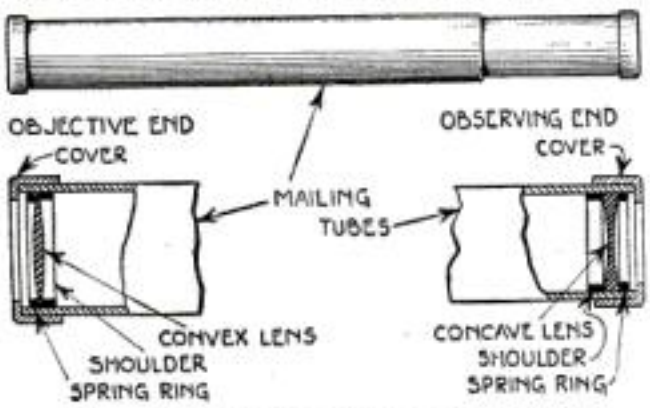
The rings can be purchased in a sporting-goods store for about one dollar apiece; the rope may be obtained at any hardware store.

Instead of having an extra piece of rope for rope-climbing, the two short lengths can be joined together, thus reaching the ground.

Mailing-Tubes Used in Making a Spy-Glass

A SATISFACTORY spy-glass can be made of two mailing-tubes and two lenses in a short time.

Procure two ordinary mailing-tubes about 1½ in. in diameter and 15 in. long, that will slide, one within the other, fairly snugly. In one end of each tube, about 1 in. back from the edge, put a shoulder of thick cardboard around on the inside, fastening with glue. Set a lens against this shoulder and then hold it in place



From two mailing-tubes and a set of lenses a good telescope may be made

with a ring of spring wire. A cover for the end of the tube should then be made of a tin-can cover that slips over the end of the tube and has a hole cut in the center. A convex lens is used in the objective or large tube and a concave lens in the smaller one.

Blacken the inside of the tubes if possible with a mixture of lamp-black and turpentine.

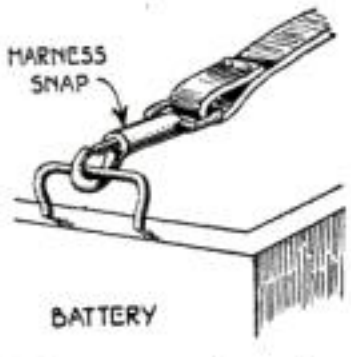
The length of the tubes depends upon the combined focal length of the pair of lenses, but any optician will tell you just what lenses to buy.

Give the outside of the tubes a coating of shellac to protect them from the weather and your spy-glass is done.

By extending the tubes or pushing them together the proper focus can be quickly obtained.—L. B. ROBBINS.

A Homemade Handle for Your Automobile Battery

EVERY one using a storage battery in his automobile will have to lift it in or out occasionally. This invariably necessitates the use of both hands and considerable exertion, as the battery case is bulky, heavy, and hard to handle.



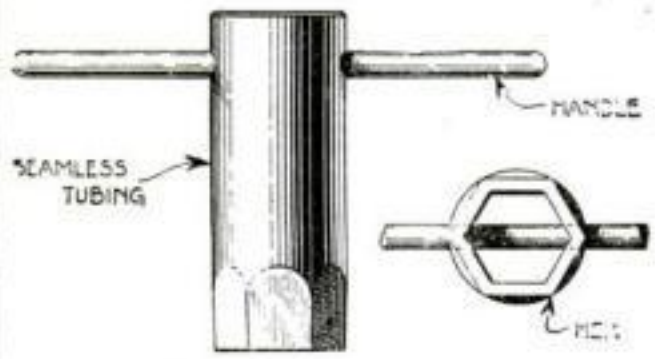
Make your work easier with this battery handle

A very useful device for lifting the battery can be made by fastening a harness snap with rivets to each end of a stout leather strap of sufficient strength to support the weight of the battery. Such a handle makes it much safer and easier to move the heavy weight, and insures the battery against injury due to breaking one or more jars.—RONALD L. PRINDLE.

A Wrench that Is Made of Seamless Tubing

A SOCKET-WRENCH is always a handy tool about a shop or garage, and at times it is indispensable. One that fulfills all the requirements of the purchased tool can be made easily.

The wrench shown in the illustration was made to fit the head of a ⅜-in. standard cap-screw with hexagon head. A piece of ½-in. seamless tubing was procured and the head of an old cap-screw ground to a taper. The end of the tubing was then heated and forced on the head. After heating again, the socket end of the tubing was forged about the head of a ⅜-in. cap-screw. The shank end of the wrench was drilled for a piece of ¼-in. drill-rod, which was used as a handle.



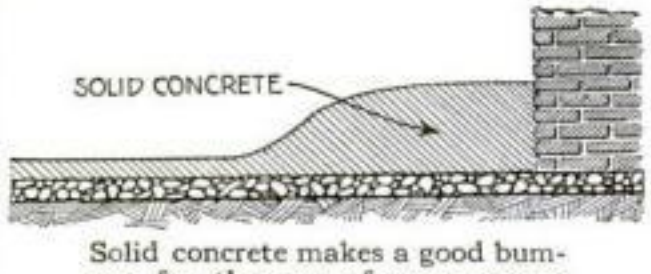
Key-wrenches are easily made of seamless tubing

By using various sizes of tubing, a complete set of wrenches may be made for either hexagonal or square heads. The shanks may be forged to fit a handle which is interchangeable with the complete set. If there is no seamless tubing to be had, iron pipe may be substituted, although it does not have the lasting qualities of the tubing.—LOWELL R. BUTCHER.

To Make a Cement Bumper for the Garage

TO prevent running the automobile through the back of a closed garage, a cement bumper can be built either when building the drive and cement floor or years later. This is done by making a hill of cement about 16 in. high and starting the incline about 3 ft. from the wall.

Before constructing, examine the front end of the automobile to see whether or not it carries a bumper and how high the hill should be built to leave clearance for any front appliances that may be added. The hill should be made just abrupt enough that in the event of the automobile's starting to ascend, it would be met by such resistance as to cause it to roll backward.—J. ALEXANDER.



Solid concrete makes a good bumper for the rear of your garage

Constructing a High-Voltage "B" Battery

By Thomas W. Benson

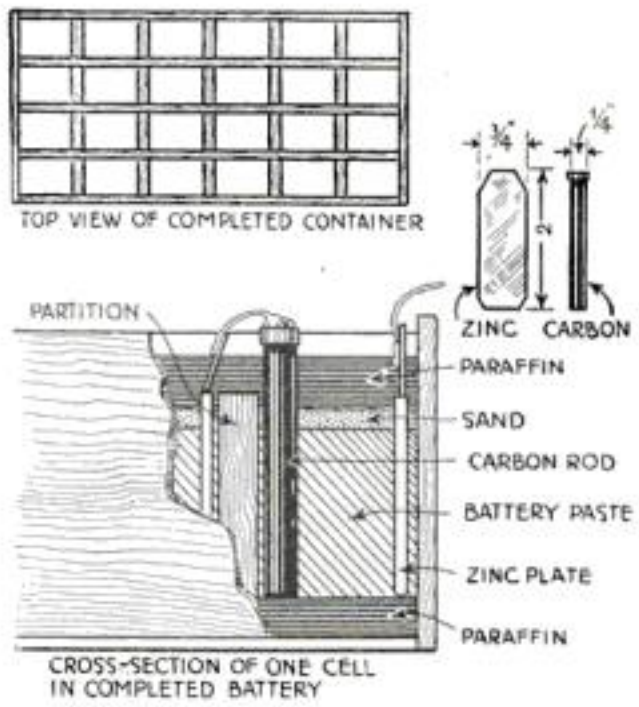
DO you want to make an easily renewable and cheap battery for the plate circuit of your audion? This tells how the writer constructed dry-cells to deliver 32 volts, at a total cost of about 50 cents.

The container was made from a cigar-box partitioned off into 24 compartments by means of hardwood strips 5/16 in. thick and ⅞ and 1¾ in. wide, respectively. The wide strips run from end to end of the box laid on edge. The narrow strips are cut into 1¾-in. lengths, 20 of them being required. The ends must be cut square with a miter-box.

One side of the cigar-box is removed. The remaining corners are nailed tight with ⅜-in. brads. The box and strips are then boiled in paraffin, and while the paraffin is still soft are assembled in the box. Only the longer strips are fastened with brads; the others are wedged into place. The side of the box that was removed is now nailed in place. Melted paraffin is poured into the cells to a depth of ¼ in. This seals the bottoms of the cells and helps retain the strips. Any cracks that appear at the joints can be sealed by passing a hot iron over them.

The container is then tested. Fill the cells with salty water. Connect a telephone receiver and battery in series, and dip the ends of the leads into adjoining cells to determine whether there is a leakage. To remove any short circuits use the hot iron as before.

To assemble the cells, take a new No. 6 dry-cell, cut off its zinc shell and



It costs very little to make a high-voltage battery like that described here

remove the black substance inside. Add to it half as much flour and sufficient 10-per-cent sulphuric-acid solution to make a thick paste.

The zinc shell is flattened out and cleaned with sandpaper. It is then cut into 24 pieces measuring ¾ by 2 in. The corners of these pieces can be trimmed off as shown, if desired. For the carbon elements use sticks 2 in. long and ¼ or ½ in. in diameter. These can be obtained from old pocket-light batteries or from the B batteries at present on the market. They have brass caps fitted, and serve the purpose nicely.

The prepared mixture is distributed evenly among the cells, taking care that none gets on the top of the partitions. Put a carbon stick and a zinc sheet in each cell. The zincs, however, are wrapped in porous paper toweling or filter paper for 1½ in. of their length. Double a piece of paper 3 by 2 in. the long way, insert the zinc between the folds, and turn back the ends. The zinc can then be pushed into place. The wrapping prevents local action of the zinc. Each cell gives about 1.3 volts. On short circuit it will give 0.5 ampere.

When the elements are placed, cover the paste with clean sand nearly to the top of the partitions and pour in paraffin to cover the cells and partitions. After the paraffin has hardened, the cells are connected in series by short soldered leads from the zinc of one cell to the carbon of the next. Bring out leads as desired. When the connections are completed, more paraffin may be poured in. The box may be painted and the lid replaced to give it a finished appearance.

Should the voltage drop off after several months, it may be brought back temporarily by inserting a heated nail through the top paraffin and injecting a solution of sulphuric acid.

When finally worn out, the battery may be completely rebuilt from one No. 6 dry-cell. Simply disconnect the zinc terminals and pull out all the electrodes with a pair of pliers after warming the battery slightly. Scrape out the paraffin and remove the dried paste. The new paste may be put in, the old carbons used again, and new zinc sheets inserted. The paraffin may be melted over and used again. The cost of making and maintaining such a battery is extremely small.

How to Make a Good Fishing-Pole from a Cheap One

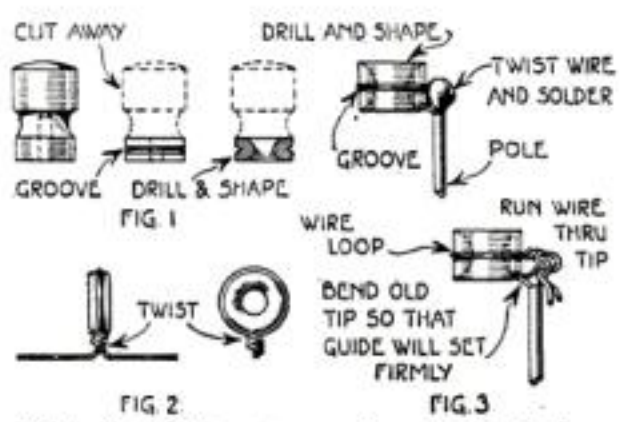
By Frank W. Harth

EVERY fisherman takes particular pride in his pole with agate line-guides, etc., if he is fortunate enough to own one. But a pole so equipped costs considerable money.

The illustration clearly illustrates how a cheap fishing-pole, equipped with only simple wire guides, may be converted into an efficient and satisfactory pole with guides that are every bit as good and work just as well as the expensive pole.

The operation of converting one to the other is simple, but takes a little time and patience. To remove the guides from the old pole take a pair of pincers and unwrap the wire which assists in holding the wire guide in place. If the solder that is left still holds the guide firmly, it can be removed by placing the guide over a torch flame, or even an ordinary gas-stove plate will do. Be careful not to remove too much of the solder, as the amount which is left will serve as the tinned surface to which to solder the new guides.

The new guides, instead of being made from expensive agate, are turned from scrap ivory knobs taken from an old electric instrument. Figure 1 shows how the guides were made. A lathe is not at all necessary, in fact, a good knife and file are all the tools that were used.



Details of the accessories required for converting the cheap pole into a high-class one

The guide-holders are made from paper-fasteners straightened out, wrapped once around the groove in the guide, and then twisted, leaving two ends for soldering. Figure 2 shows the holder loop in detail.

By holding the wire in place on the pole with a pair of pliers, one end can be soldered into place. After one side is soldered, the finishing of the other side is a simple matter. The superfluous lead is then trimmed off with a knife and file.

The tip was made in the same way, except that the other end of the knob was used.

Figure 3 shows how the tip was fastened and then soldered into place. It is not necessary to wrap the wire on again, as the guides will hold just as well.

The rebuilt pole, although not as fancy as a professionally made pole, looks fairly well and, what is more, works just as well.

Drawing on Fungus—a Novel and Pleasing Art

By Anthony E. Zipprich

THE fungus is a form of plant life with the uses of which comparatively few people are acquainted.

One class, popularly called shelf or bracket fungus, may be used for decorative purposes. Pictures may be drawn on its flat surface. The bracket fungus is found most often in the shape of a semicircular bracket, varying in size from 1 in. to 2 ft. in diameter and attached to dead stumps and fallen logs—beech-trees particularly.

One side, the upper, is a hard woody surface, brown in color, with concentric rings similar to the year-rings of a tree. The under side in most specimens is a pure white which, on the slightest rub, becomes a sepia brown. It is this side on which the artist can work.

In fungus-hunting, which is fun in itself, the artist needs but few materials—a chisel to pry off the brackets, a

The largest and whitest fungi may be found in the thickest and darkest woods

hammer, and some receptacle to hold the specimens so that their sensitive white surfaces do not rub or touch one another. A box with several shelves and a handle for carrying will answer.

To obtain good, untarnished fungi, it is necessary when chiseling them from the log or stump to make sure that the bracket comes off without breaking and without falling to the ground. If this should happen, as is sometimes the case, and it falls on its white face, the specimen is spoiled.

Having a few good specimens, the artist is ready for his work. A simple set of tools is now necessary, consisting of three or four sticks sharpened to various degrees of fineness and a clean rag. A stylus and the file blade of a pocket-knife are even better than the sticks. One of the sticks should be sharpened to a flat chisel point, which tool can be used to secure background and shadow effects.

When the artist has determined on his sketch, a portrait, landscape, building, or a copy of a picture, he must remember that a mark once placed upon the fungus cannot be erased. A misplaced line or badly proportioned object cannot be rectified.

The reason for this is simple. The

Highly pleasing artistic effects may be produced by etching portraits on fungi

"etching side" of a fungus, when freshly picked, is very slightly moist and pure white. This white surface, however, is only about as thick as paper. Directly beneath it is the body of the bracket, a rich deep brown, exactly the color of the photogravure pictures in many Sunday newspapers. The scratch of a pin or the cut of a knife will expose this beautiful brown underneath, leaving a permanent mark.

The exactitude required is precisely what fascinates and makes the art alluring.

An artist in making his first attempt will do well not to block in his subject, but rather to make small dots on the white surface at important parts of his composition, which points can then be connected. The proportions and outlines are then sure to be correct and true in perspective. The technique of the artist and his method of handling will be greatly enhanced in consequence.

To keep the lines of the subject clean and sharp, a linen rag should be alongside of the worker. In the process of etching, the tool gathers up small parts of the white material, and as a crisp, sharp line is hard to get with a clogged scriber, it must be wiped on the cloth after every line. When this is done, no

The velvety white under side of the fungus offers an excellent medium for the artist's stylus

specks or crumbs stick to the picture and the results are more satisfactory.

Fungus etching will give keen delight to any individual skilled in the use of the pen or engraving tool. It has, or may seem to have, serious drawbacks when one is not well acquainted with its peculiarities. One of these drawbacks is the tendency of the fungus to dry up and become unworkable, sometimes within twenty-four hours. However, a dried shelf or bracket can be put in working condition by placing it in a damp atmosphere overnight or by hanging a damp rag over it. The time required for this varies and is only learned by experience.

The tendency of fungi to dry and become hard should be kept in mind and only so many brackets should be collected as an artist can conveniently etch in the course of one day.

A second and also a serious difficulty relates to the color of the working side of a bracket. The finest and whitest specimens are found in the deepest woods where little or no sunlight penetrates. When they are brought out in the daylight, some turn a light brown or pink after several days. To prevent or lessen this, they should be etched only in subdued light, or, if this is not feasible, they should be left in the sun

Great care must be exercised to prevent the fungi from becoming marred by scratches

no longer than the time required to finish the sketch. With the picture completed and the fungus dried up, the tendency to "yellow" will be largely lessened.

As stated at the beginning of this article, effects like the mezzotints of the old English masters can be secured; wood-engraving and charcoal studies likewise have their counterparts in the fungus medium.

The water-colorist will find the white surface of hard and dry unused fungus a very fine medium for his brush. While the writer has never attempted oil-painting on them, it is within the range of possibility that this form of the graphic arts can also be successfully applied to fungi, but etching seems, after all, the most logical and appropriate method of utilizing fungi for artistic purposes.

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TRADE MARK
UNION MADE

THE out-door man, perhaps more than any other, knows the keen zest of a good cigarette.

Among such men, Fatima is noticeably a favorite. This is due to its delicately balanced Turkish blend — a blend which entirely lacks "heaviness" or any quality which might dull the edge of one's enjoyment.

It is this blending, too, which imparts to Fatima its unusually pleasing taste.

Liggett & Myers Tobacco Co.

FATIMA
CIGARETTES